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What is a Euro Worth? The Market Value of Cash of Eurozone Firms

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Biographical Note

Miguel Fernando Taveira Guimarães was born in Braga in 1995. His curiosity for management and economics led him to pursue a management degree at the University of Minho, which he completed in 2016. This degree fuelled his interest in finance and ultimately contributed to his enrolment in Faculdade de Economia do Porto's Master in Finance, which culminates with this dissertation.

He is starting his professional career at Deloitte's Financial Advisory practise.

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Abstract

The relative holdings of cash by firms have been on a markedly upward trend over the past few decades, increasing the importance of appropriate cash management policies for these firms and the relevance of cash holdings as a subject of study. This research is aimed at exploring how the market values the cash holdings of Eurozone firms and what variables drive that valuation, complementing existing studies by providing insights for Euro area firms during the period of the European sovereign debt crisis, absent in the existing literature.

Our methodology relies on panel data, with both pooled OLS and firm fixed effects models being estimated. The sample comprises 2648 firms from 12 Eurozone countries and spans 12 years, from 2005 to 2016. Data were retrieved from the *Datastream* database.

We find the impact of the level of cash (negative), leverage (negative), the available investment opportunities (positive), the uncertainty of cash flows (positive) and firm age (negative) on the marginal value of cash to be statistically significant, as well as consistent with our initial hypotheses and the existing literature. In contrast, we obtain contradictory results for the effects of the quality of corporate governance (negative), acquisition activity (positive) and the financial crisis (negative), with both the period of the crisis and the most affected countries being associated with lower marginal values of cash. These results are robust to alternative specifications and suggest that precautionary reasons are the main drivers of the value of additional units of cash.

We conclude by providing general practical recommendations for both firm managers and policymakers, grounded in our conclusions.

Key-words: Cash holdings; market value; Euro; corporate governance; financial constraints; financial crisis.

JEL-Codes: G01, G32, G39

Resumo

A posse de liquidez por parte das empresas tem vindo a aumentar significativamente ao longo das últimas décadas, amplificando a importância de políticas de gestão de liquidez apropriadas e a relevância da liquidez como objeto de estudo. Esta investigação visa explorar o modo como o mercado avalia a posse de liquidez de empresas da zona Euro e quais as variáveis que influenciam essa avaliação, complementando os estudos existentes ao providenciar conclusões para as empresas da zona Euro durante o período da crise soberana europeia, ausentes da literatura sobre o tema.

A nossa metodologia baseia-se em dados em painel e na estimação de modelos *pooled OLS* e efeitos fixos. A amostra do estudo é composta por 2648 empresas provenientes de 12 países da zona Euro e abrange 12 anos, de 2006 a 2016. Os dados foram retirados da base de dados *Datastream*.

Os resultados para o impacto do nível de liquidez (negativo), alavancagem (negativo), oportunidades de investimento disponíveis (positivo), incerteza dos fluxos de caixa (positivo) e idade (negativo) no valor marginal da liquidez são estatisticamente significativos, assim como consistentes com as nossas hipóteses iniciais e com a literatura existente. Por outro lado, os resultados para o efeito da qualidade de *corporate governance* (negativo), da atividade de aquisições (positivo) e da crise financeira (negativo) são contrários ao esperado, estando o período da crise e os países mais afetados pela mesma associados a valores marginais de liquidez inferiores. Estes resultados são robustos a especificações alternativas e sugerem que os motivos de precaução são os principais fatores determinantes do valor de unidades adicionais de liquidez.

Concluímos fornecendo recomendações práticas para gestores e decisores políticos, suportadas pelas nossas conclusões.

Palavras-chave: Liquidez; valor de mercado; Euro; *corporate governance*; restrições financeiras; crise financeira.

Classificação JEL: G01, G32, G39

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1. Introduction

The subject of corporate cash holdings has received increasing attention from academics and practitioners alike as the result of the burgeoning cash in companies' balance sheets worldwide. Graham and Leary (2017), for instance, find that cash as a percentage of total assets for US firms has increased from just over 5% in the 70's to almost 25% in the 00's. Bates, Kahle, and Stulz (2009) note that cash holdings by US firms had increased so much that average net debt was negative in 2004, 2005 and 2006. In the EMU, Ferreira and Vilela (2004) find that the average firm in their sample held 15% of total book value of assets in cash in 2000, whilst our sample's average firm had a 13% cash ratio in 2016. Companies like Apple, which as of the Q3'17 held $262Bn in cash, the largest cash balance of any company and a third of its market value, have been pressured by activist investors to distribute its cash.

This increased relative importance of cash holdings motivates and adds relevance to research aimed at exploring not only how companies decide on their cash levels, but also how the market values those cash holdings. This study focuses on this latter, less explored strand of literature, whose conclusions can shed light on how managers can manage cash balances and payout policies to increase firm value, their ultimate goal, as well as how policymakers can go about setting incentives to improve capital allocation within the economy.

In a setting of imperfect markets, the literature identifies several benefits and costs of holding cash companies take into account when deciding on cash management policies. Keynes (1936) suggests that accumulating cash allows firms to reduce transaction costs from frequent sourcing of capital in external markets and decreases the chance of shortages of capital when access to those markets is costly or unavailable (Myers & Majluf, 1984). However, holding excess cash entails foregoing potentially more profitable investments (Kim, Mauer, & Sherman, 1998) and increases the likelihood of self-interested, value destructive actions by managers (Jensen, 1986).

Several studies concerning the market value of cash holdings attempt to identify how the market values corporate cash depending on firm characteristics. For instance, investment opportunities, the uncertainty of cash flows (Bates, Chang, & Chi, 2017; Pinkowitz & Williamson, 2005), the degree of financial constraints (Faulkender & Wang, 2006) and the quality of corporate governance (Dittmar & Mahrt-Smith, 2007) are generally found to be

associated with a higher marginal value placed on cash, while increasing levels of cash and leverage generally have the opposite effect (Faulkender & Wang, 2006).

This study seeks to complement the existing literature by focusing on Eurozone firms and on the period around the financial crisis of 2008. More specifically, and in addition to 1) testing the impact of the aforementioned variables on the value of cash of Eurozone firms, an analysis absent in the literature, the study focuses on 2) how the crisis impacted the valuation of cash by the market, with particular emphasis being placed on the increased financial constraints faced by firms throughout this period, most notably those incorporated in the countries that underwent EU intervention during the European sovereign debt crisis - Greece, Portugal, Ireland and Spain[1]. Such analysis is lacking in the literature and the respective findings can improve our understanding of how cash is valued in a setting of increased financing constraints.

The methodology used is based on panel data, spanning from 2005 to 2016, and follows the empirical model of Faulkender and Wang (2006). The base model sample is comprised of 2648 individual firms from 12 Eurozone countries.

Our findings suggest that variables such as the available investment opportunities, the uncertainty of cash flows, the degree of financial constraint and acquisition activity positively impact the marginal value of cash, whilst the level of cash held, leverage, the quality of corporate governance, the period of financial crisis and being headquartered in the aforementioned countries are negatively related to it. Most of these results are statistically significant and consistent with the existing literature, apart from the effects of the quality of corporate governance, acquisition activity and the financial crisis of 2008.

The remainder of the study proceeds as follows. Chapter 2 reviews the existing literature on the benefits and costs of holding cash, as well as on the value placed by the market on cash holdings. Chapter 3 details the hypotheses the research seeks to test. Chapter 4 describes the methodology followed and data used. Chapter 5 presents the results, their interpretations and consistency with the theoretical hypotheses and existing literature. Chapter 6 provides concluding remarks, practical recommendations and suggestions for future research.

[1] Cyprus also received assistance from the EU, but Cypriot firms are not included in our sample because Cyprus was not part of the Eurozone at the start year of our sample.

2. Literature Review

2.1. Benefits and Costs to Holding Cash

In a world of perfect markets, where market frictions such as transaction costs, taxes, asymmetric information and bankruptcy costs do not exist, any financing decision is irrelevant (Modigliani & Miller, 1958; Stiglitz, 1974) and therefore value neutral. In this setting, any firm can finance all its value-increasing investment opportunities with external capital and cash is nothing more than negative debt – any increase in cash from debt has no impact on shareholder value. However, the introduction of such frictions can render shortages of liquid assets costly for the firm, increasing the importance of cash management policies seeking to balance the marginal benefits and costs of holding cash in order to maximize firm value (Opler, Pinkowitz, Stulz, & Williamson, 1999).

The literature on the benefits and costs to holding cash points to several motives driving firm's cash management decisions, which in turn constitute the basis for the three most relevant theories attempting to explain how those decisions are made: the trade-off theory (Ferreira & Vilela, 2004; Kim et al., 1998; Opler et al., 1999), the pecking order theory (Myers, 1984) and the free cash flow theory (Jensen, 1986).

The benefits of holding cash are mostly related to Keynes' transaction, precautionary and speculative motives (Keynes, 1936).

The transaction motive for holding cash posits that cash allows firms to avoid the transaction costs associated with selling real or financial assets when funds are needed. A shortage of liquidity to fund positive NPV investment opportunities or service debt will require the firm to raise funds in external markets or liquidate assets, both of which can be costly (Opler et al., 1999). For example, Hennessy and Whited (2007) estimate the cost of equity flotation at 5%-11% of total capital. In the presence of such transaction costs, cash is no longer simply negative debt.

Miller and Orr (1966) model the demand for cash by firms as a function of the fixed costs borne when converting cash substitutes into cash and propose the existence of economies of scale in cash management, which suggests that firms which usually source smaller amounts from capital markets, presumably smaller firms, tend to hold more cash to avoid frequent trips to the markets. Mulligan (1997) finds support for such hypothesis.

The precautionary motive posits that firms hold cash to ensure good investment opportunities can be funded when external financing is costly or even unavailable. Myers and Majluf (1984) argue that information asymmetries may lead firms to pass good investment opportunities: under asymmetric information, investors know managers will not issue shares if the undervaluation of the company is higher than the NPV of the project. Therefore, intentions to issue shares are viewed as less good, leading investors to discount the value of the firm in order to avoid overpaying. This anticipated behaviour can, in turn, lead the firm to decide not to issue new shares and, consequently, not to invest, resulting in a reduction of firm value. Greenwald, Stiglitz, and Weiss (1984) further argue that informational asymmetries increase the cost of external finance, with debtholders charging higher interest rates on debt and shareholders discounting the value of the firm when equity is issued, in line with the hypothesis of Myers and Majluf (1984). Higher levels of liquidity thus allow firms to build slack, finance good projects and service debt regardless of market conditions, which suggests that firms should accumulate cash as much as possible.

Somewhat similarly, Fazzari, Hubbard, and Petersen (1988) propose that when facing financial constraints, resulting from imperfections in capital markets, firms' investment will be determined not only by the availability of positive NPV investment opportunities, but also by the availability of internal funds. Almeida, Campello, and Weisbach (2004) build upon this work by modelling the propensity of constrained firms to save more cash out of their cash flow. Unlike unconstrained firms, which can fund all current and future investment opportunities, constrained firms must trade-off current and future investments to decide on an optimal level of cash, which increases the probability of being able to fund future investment opportunities at the expense of taking current valuable ones.

Han and Qiu (2007) extend the model of Almeida et al. (2004) by considering not only the level of cash flow, but also its volatility, explicitly modelling the precautionary motive for cash holdings as a function of cash flow volatility. They hypothesize that firms facing higher cash flow volatility, in a setting where cash flow risk is not fully diversifiable, will tend to be more prudent by holding more cash and decreasing current investment to better position themselves to face future investment needs.

Empirical evidence supporting the precautionary motive is plentiful. Almeida et al. (2004) and Han and Qiu (2007) both find support for their theoretical models, showing that constrained firms tend to save more cash out of their cash flow, even more so if the cash

flows are volatile. In the US, Opler et al. (1999) observe that firms with more volatile cash flows and investments, smaller size and better growth opportunities tend to hold more cash, ensuring debt service and investment needs are met even when cash flow is low or external financing is too expensive. In contrast, larger firms and those with credit ratings tend to hold less cash, given they usually have easier and less costly access to capital markets (Hennessy & Whited, 2007). Further evidence from the US (Kim et al., 1998; Mikkelson & Partch, 2003), the UK (Ozkan & Ozkan, 2004), the EMU (Ferreira & Vilela, 2004) and Australia (Lee & Powell, 2011) reach very similar conclusions. In addition, Bates et al. (2009) find that the large increase in cash holdings in US firms throughout the preceding decades can be largely explained by the precautionary motive, given that cash flow volatility and R&D investment (external financing is often more expensive for R&D expensive firms, since they hold more intangible, information asymmetry prone assets) have increased.

Finally, Keynes (1936) also suggests that firms can accumulate cash for speculative reasons, seizing opportunities to buy goods or assets at bargain prices or taking advantage of interest and exchange rate fluctuations (Ross, Westerfield, & Jordan, 2012). To the best of our knowledge, no empirical research on the speculative motive for holding cash exists.

Regarding the costs of holding cash, the literature mostly points to the opportunity cost of holding cash and agency costs as the main disadvantages of holding cash.

Opler et al. (1999) and Kim et al. (1998) both note that holding cash bears significant opportunity costs under the form of less liquid but more productive investments, suggesting firms should trade-off this cost against the aforementioned benefits of holding cash. Kim et al. (1998) find that the larger the difference in return between firms' physical and liquid assets is, the less cash they tend to hold, supporting the theoretical prediction.

The agency cost of cash was first proposed by Jensen (1986), who argued that the accumulation of excess free cash flow – cash flow generated in excess of what would be required to fund all available positive NPV investment opportunities – by managers exacerbates the conflict of interest between them and the firm's shareholders, given managers can use the excess cash to engage in empire building but value-destroying activities or to accumulate cash, increasing the firm's internal financing capacity and thereby avoiding the monitoring that frequent trips to the capital markets entail (Easterbrook, 1984).

Some empirical studies support this motive for holding cash. Blanchard, Lopez-de-Silanes, and Shleifer (1994) document that managers of firms without attractive investment opportunities tend to retain cash from cash windfalls, later using it in acquisitions. Harford (1999) and Harford, Mansi, and Maxwell (2008) report that firms with excess cash tend to spend it in acquisitions and CAPEX. However, authors such as Opler et al. (1999) and Ferreira and Vilela (2004), who study the determinants of cash holdings in the light of the several theories, find no substance for this motive. Similarly, Mikkelson and Partch (2003) conclude that firms with excess cash actually perform better, while Duchin, Ozbas, and Sensoy (2010) note that excess cash can be valuable, as it allows firms to continue investing in times of higher financial constraints. Dittmar, Mahrt-Smith, and Servaes (2003) argue that this mixed evidence results from a focus on US firms, which enjoy better investor protection. The authors find that in countries with poorer investor protection companies hold significantly more cash, supporting the agency motive.

Aside from the more traditional benefits and costs to holding cash identified by the literature, already discussed, Foley, Hartzell, Titman, and Twite (2007) hypothesize that the decision to tax repatriated foreign income can explain the decisions of US companies with regards to the accumulation of cash. Consistently, they find that firms that facing higher taxes when repatriating cash hold more cash.

2.2. Cash Holdings Theories

The benefits and costs of holding cash identified by the literature have spawned several theories attempting to explain how firms decide on their cash policy. Following Ferreira and Vilela (2004), three theoretical models attempt to explain cash management decisions: the trade-off theory, the pecking order theory and the free cash flow theory.

The trade-off theory suggests that the level of cash held by firms results from a deliberate weighing of the benefits and costs of holding cash, with the optimal level of cash being reached when the marginal benefit of cash equals its marginal cost (Ferreira & Vilela, 2004; Kim et al., 1998; Opler et al., 1999).

The model developed by Myers and Majluf (1984) and the observations of Myers (1984) underpin the pecking order theory, which proposes that firms tend to prefer internal

financing to external financing because of the costs of the latter, most notably costs of financial distress, in the case of debt issues, and particularly harmful asymmetric information and flotation costs, in the case of equity. Therefore, the theory argues that retained cash will be the primary source of financing and firms will accumulate as much of it as possible in order to decrease the likelihood of having to raise external financing to fund positive NVP investment opportunities. Unlike the trade-off theory, the pecking order theory is unsupportive of the existence of an optimal level of cash.

Finally, the free cash flow theory of Jensen (1986) suggests that managers use excess cash for their own benefit, at the cost of the shareholders' welfare, by either wasting it in compensation or ego increasing investments, such as acquisitions, or retaining it in order to increase their independence from external markets and the discipline they impose.

2.3. Empirical Evidence from the Market Value of Cash

The majority of the aforementioned empirical studies seek to test the motives for holding cash, as well as the related theories, by focusing on how well certain variables – the determinants of cash holdings - explain the cash held by companies, in an attempt to understand what factors managers take into account when deciding on cash policies. This company-centric view is complemented in the literature by studies focusing on the point of view of the market, aimed at understanding how the market views the cash held by companies by studying how it values that cash and how that valuation varies depending on company characteristics.

In a time where little to no evidence on the market value of cash was available, Pinkowitz and Williamson (Pinkowitz & Williamson, 2005, 2007) attempted to study the impact of differences in investment opportunities, predictability of investments, uncertainty of cash flows, degree of financial constraint and probability of financial distress in the market valuation of cash. Using, in both cases, a sample of over 13000 US companies, spanning from 1953 to 2001 in the first case and 1965-2004 in the second, they find evidence that cash is more highly valued in firms with better investment opportunities, more uncertain investment programs and cash flows, as predicted by theory and supporting the precautionary motive. Furthermore, their evidence substantiates the hypothesis that cash holdings have a lower value when financial distress is more likely, given higher levels of cash

benefit bondholders more than shareholders in this situation, as proposed by the agency theory of Jensen and Meckling (1976) and demonstrated by contingent claim analysis (Black & Scholes, 1973). In addition, insufficient and mixed evidence is found corroborating the theoretical prediction that more constrained firms hold more valuable cash, with results depending on the methodology and proxies for financial constraints used. Overall, the results appear most supportive of the trade-off theory, especially when considering findings suggest the existence of an optimal level of cash.

Faulkender and Wang (2006) present a seminal article in the literature on the market value of cash, following Pinkowitz and Williamson (2005) by studying the value of cash in US firms but focusing on financial policy as opposed to investment policy. The authors identify three cash regimes companies can belong to and their market value of cash is related to, namely (i) "distributing cash", for companies carrying excess cash – defined as high levels of cash in firms with bad investment opportunities, (ii) "servicing debt or other liabilities", for companies carrying sizeable amounts of debt and (iii) "raising cash", where companies which need to raise cash in order to meet investment needs.

They hypothesize that the valuation of cash in the first group will be below $1 due to differences in interest taxation between firms and individuals, taxes on dividends and agency problems, as suggested by Jensen (1986); the highly levered firms, in the second group, should theoretically also have a lower value placed on their cash compared to low leverage firms, given that value accrues mostly to bondholders when cash increases in these firms as previously described; firms in the third group are expected to have a value of cash above $1, since retained cash is cheaper than externally raised cash by the amount of the transaction costs. This valuation is expected to be higher in constrained firms, since they face higher transaction costs and information asymmetries than unconstrained ones.

The authors find support for all of their hypotheses. Firstly, increasing cash balances negatively impact the value of cash, as the firm is less likely to be constrained as its cash balance increases and more likely to suffer from Jensen's (1986) free cash flow problem. Secondly, cash is less valuable in highly levered firms. Finally, cash is more valuable in financially constrained firms, as these firms face costlier external financing and are thus more likely to forego positive NPV projects due to lack of internal funds, as suggested by Myers and Majluf (1984). Therefore, the findings of Faulkender and Wang (2006) support the

transaction, precautionary and agency motives for holding cash, as well as the trade-off and free cash flow theories.

In a contemporaneous study, Pinkowitz, Stulz, and Williamson (2006) attempt to link the degree of investor protection and capital market development to the valuation of cash across different countries, hypothesizing that cash will be less valuable in countries where investor protection – in both of its components, the prevalence of legal rights and their enforcement - is poorer, since it is easier for controlling shareholders to take advantage of liquid assets to their own benefit. Using a sample of 35 countries and 11 years, the authors conclude that cash is valued at a significant discount in countries where investor protection is poor, which corroborates their hypothesis. The findings support those by Dittmar et al. (2003) and Ferreira and Vilela (2004), who report that firms in countries with poor investor protection tend to hold more cash, as predicted by the agency motive for cash. Investors discount the value of cash in these countries because excess cash is used to increase the utility of the controlling shareholders at the expense of the others.

Dittmar and Mahrt-Smith (2007) empirically address the relation between corporate governance and the valuation of cash in US firms. Using proxies for takeover protection and the presence of large shareholders as representative of the quality of corporate governance, they find that the value of cash doubles in well-governed firms – those firms where entrenchment due to multiple antitakeover provisions is less likely and monitoring by large shareholders is more significant - when compared to poorly governed ones. The findings are consistent with those of Pinkowitz et al. (2006). In addition, the authors evaluate whether financial constraints have an impact on the valuation of cash and if poorly governed firms with excess cash tend to spend it in acquisitions. They conclude that financially constrained firms do have a higher value placed on their cash, consistent with Faulkender and Wang (2006), whilst the value destruction from poor governance is independent of acquisition activity: cash is valued at a discount in firms with poor governance, even if they do not report acquisition activity, which is out of line with the findings of Harford (1999) and Harford et al. (2008). Overall, this study supports Jensen's (1986) free cash flow theory for the level of cash holdings, given it concludes that poorly governed firms have their cash valued at a discount and dissipate excess cash quicker when compared to well-governed firms.

Denis and Sibilkov (2010) build upon previous studies on the impact of financial constraints by Almeida et al. (2004), Faulkender and Wang (2006) and Pinkowitz et al. (2006), seeking

to understand why cash holdings are more valuable for constrained firms and why some of these firms hold too little cash. Using a sample of US companies, they find that the increased value placed on the cash of financially constrained firms – between 14 and 51 cents - results from the increased ability of firms with cash to take on valuable investment opportunities when external markets are harder or costlier to access. Furthermore, investment appears to be more valuable for constrained firms, which further highlights the importance of cash in these firms. The counterintuitive finding that some constrained firms hold too little cash is explained by a lack of cash flow generation in some firms, which combined with difficult access to external financing drains their cash balances.

These results agree with those by Opler et al. (1999), Faulkender and Wang (2006) and Almeida et al. (2004) and indicate that constrained firms can improve their value by retaining more cash. Contrarily, they are unsupportive of constrained firms holding higher cash reserves due to agency problems, as predicted by the free cash flow theory.

Drobetz, Grüninger, and Hirschvogl (2010) analyse the impact of information asymmetry in the value of cash in order to empirically test two of the three theories previously described, with opposite predictions: the pecking order theory of Myers and Majluf (1984) predicts that the value of cash should increase with information asymmetry, as external financing becomes costlier as this asymmetry increases, whilst the free cash flow theory of Jensen (1986) suggests that information asymmetry exacerbates the agency problems of cash, leading to a lower value placed on cash.

The authors find that whilst cash is valued at roughly face value under normal circumstances, its valuation decreases significantly when firms face high levels of information asymmetry, which leads to the conclusion that the agency costs of free cash flow outweigh the benefits of financial slack resulting from cash hoarding. Moreover, this conclusion is the same when excess cash instead of total cash levels are used and splitting the sample on governance quality shows that the influence of information asymmetry is lower for firms with good governance, further supporting Jensen (1986)'s free cash flow theory.

Tong (2011) tackles the impact of diversification on the valuation of cash by testing four hypotheses: (i) diversification should increase the market value of cash in financially constrained firms, as firms of the same group can make use of the cheaper internal capital market when needing capital; (ii) diversification can be the result of empire building by

managers, which would lead to a discount being placed on the value of cash; (iii) the value of cash for financially constrained firms is lower if they are diversified, as the increased debt capacity from uncorrelated cash flows of the several businesses decreases the degree of constraint, and (iv) diversification increases the value of cash because it reduces bankruptcy risk, with benefits from higher levels of cash accruing more to shareholders than to bondholders when bankruptcy risk is low.

Tong (2011) reports that the average effect of diversification on the value of cash is negative (minus $0.16 compared to single segment firms), as well as equally negative for constrained and unconstrained firms. These findings are most consistent with the second hypothesis, where diversification results from value-destroying empire-building behaviour by managers, as hypothesized by the free cash flow theory of Jensen (1986).

Lee and Powell (2011) focus on the impact of excess cash on shareholder value of Australian firms, particularly on how persistently large cash reserves impact said value. Using the model by Opler et al. (1999) to identify the optimal level of cash and considering excess cash firms as those that maintain cash levels 1.5 standard deviations above the optimal level, the authors identify persistent excess cash firms as those which hold excess cash for periods of two or more years. Holdings of excess cash are best explained by the trade-off model, with the determinants of cash holdings in Australia being the same as in the US (Opler et al., 1999) and UK (Ozkan & Ozkan, 2004), for instance. However, the marginal value of cash is found to decrease over time for firms persistently holding excess cash, which corroborates the free cash flow theory and directly contradicts the conclusions of Mikkelson and Partch (2003).

In a different study, Martínez-Sola, García-Teruel, and Martínez-Solano (2013) attempt to empirically test the existence of an optimal level of cash, as proposed by the trade-off theory, by using a quadratic regression to test how deviations from the optimal level of cash affect the value of the firm. The results strongly support the existence of an optimal level of cash resulting from the trade-off of the benefits and costs to holding cash, with firms having the chance to increase their value by moving towards the optimum.

Complementing the study of Lee and Powell (2011), Chan, Lu, and Zhang (2013) address how shareholders value the cash of Australian firms by studying how financial constraints, firm growth, cash flow uncertainty, product market competition and corporate governance impact the value of cash. They report the value of cash in this group of firms is an increasing

function of the degree of financial constraints faced by companies, the size of their investment opportunities and the volatility of their cash flow, as well as a decreasing function of the amount of cash held and leverage. These results are consistent with those achieved by Pinkowitz and Williamson (2007) and Faulkender and Wang (2006), corroborating the trade-off theory. However, contrarily to the findings of Pinkowitz et al. (2006) and Dittmar and Mahrt-Smith (2007) for the US, there is no evidence supporting a higher value of cash for well-governed Australian firms.

Bates et al. (2017) complemented their previous study on why cash levels had risen so much throughout the last decades (Bates et al., 2009) by addressing why the value of cash had also increased. The authors report the value of cash has increased from $0.61 in the 1980s to $1.12 in the 2000s for US firms, which contradicts the popular view that the rise in cash balances was excessive and detrimental to firm value. This increase is mainly driven by the investment opportunity set, cash flow volatility and increased product market competition in the 1990s, a decline in corporate diversification in the 1980s - consistent with Tong (2011) – and credit market risk in the 2000s. Corporate governance is found to have a positive effect, but little explanatory power over the increase in the valuation of cash. Finally, findings suggest that financial constraints play an important role, as an increase in the number of constrained firms has hindered the ability of firms with sub-par cash flow generation ability to move towards their optimal cash level, remaining below it for longer periods and commanding a higher value of cash for that reason. The overall evidence is consistent with that of their previous work, with the firm characteristics associated with the precautionary motive playing an important role in the increase of cash holdings and their value.

2.3.1. Financial Constraints, the Financial Crisis and the Market Value of Cash

A few very recent studies in the literature on the market value of cash attempt to estimate the impact of the financial crisis on the valuation of cash by the market, namely those by Bates et al. (2017) and Chang, Benson, and Faff (2017), following the work of Duchin et al. (2010) and Campello, Graham, and Harvey (2010) on the effect of financial constraints during the period.

The study by Duchin et al. (2010) shows how important cash holdings can be in times of economic and market turmoil and consequently higher financial constraints from inaccessible external financing, such as during the financial crisis of 2008. The crisis was characterized by a shock to the supply of external finance by financial institutions, which tightened credit risk standards and were very reluctant to lend during the worse period of the crisis. In this setting of increased financial constraints, firms lacking sufficient internal financing capabilities to fund profitable investment opportunities had to cut investment, with consequences for firm value. The authors find support for this hypothesis, with post-crisis investment being significantly positively related to the amount of cash held and negatively related to net short-term debt levels. Additionally, firms holding excess cash also report higher levels of investment during this period, which suggests that excess cash holdings – it is worth noting Opler et al. (1999) who, among other authors, observe that firms tend to hold levels of cash above the optimal – may have a positive effect under certain conditions.

Through a survey of 1050 CFOs during the crisis, aimed at discovering how financially constrained their firms were and the impact of such constraints, Campello et al. (2010) find that constrained firms cut spending, investment and distributions considerably more than unconstrained firms, with almost 90% of CFOs claiming profitable investment opportunities were restricted during the crisis and more than 50% of planned investment either cancelled or postponed. In addition, constrained firms spent more cash and sold more assets to fund operations. These results are consistent with those of Almeida et al. (2004), who hypothesize more financially constrained firms tend to retain more cash in order to face potential credit supply shocks, those of Fazzari et al. (1988), who show that financially constrained firms are more sensitive to macroeconomic shocks, as well as those of the literature on financial constraints and the size or value of cash holdings in general, which finds that firms hold more cash and cash is more highly valued the higher the degree of financial constraints.

Following the findings that cash-rich firms performed better during the financial crisis, due to better financing capacity (Duchin et al., 2010), Chang et al. (2017) seek to understand whether the value placed on the cash of US firms changed during the period of increased constraints during the crisis (2008-2010). Their evidence is consistent with the hypothesis that the value of cash is higher during the crisis for unconstrained firms and higher for constrained firms than for unconstrained firms during a non-crisis period. In addition, cash is more valuable for constrained firms with good governance, which helps ensure an efficient

allocation of resources when they are scarce. However, contrarily to predictions, the effect of the crisis on the marginal value of cash is lower for constrained than for unconstrained firms, with an extra dollar of cash being worth $1 less for the former when compared to the latter. This result is inconsistent with previous evidence and several explanations for it are offered: firstly, constrained firms had lower reliance on external financing prior to the crisis when compared to unconstrained firms, thus being less affected by the credit supply shock; at the same time, financially unconstrained firms likely carry more debt than constrained firms, drawing on cash to pay debt during the crisis when external financing is unavailable, which makes it more valuable for these firms; lastly, constrained firms tend to save more cash (Almeida et al., 2004) and are, therefore, better prepared for a period of increased constraints.

The previously mentioned work by Bates et al. (2017) hypothesizes, based on Duchin et al. (2010), that the two recessions that characterized the 2000s could have contributed to an increase in the demand for cash, as well as its value, as the result of increased macroeconomic uncertainty and consequently higher restrictions on external financing. They use the credit spread the spread between AAA and BBB corporate bonds as an indicator of the openness of external markets, with higher spreads being indicative of a preference for high-quality bonds relative to lower quality bonds and, therefore, of greater caution by investors when giving credit. The authors find that the widening of the credit spread in the 2000s, reflective of increased risk in the credit market as the result of the two recessions of the decade, was the most important determinant of the increase in the value of cash throughout those years, supporting the idea that increased financial constraints following recessionary periods had a positive effect on the value of cash.

Given these studies, the present dissertation seeks to contribute to the literature with further evidence on the market value of cash, encompassing the most important drivers of the value of cash identified in the reviewed literature – namely investment opportunities, uncertainty of cash flows, corporate governance and financial constraints, focusing on Eurozone countries (most studies on the value of cash holdings address the US market – see table 1, with only Pinkowitz et al. (2006) and Drobetz et al. (2010) including Eurozone countries in their sample but not studying most of the aforementioned variables), therefore serving as a direct complement to the study of Ferreira and Vilela (2004), which addresses the perspective of the companies by studying the determinants of cash holdings in Eurozone firms.

Furthermore, additional attention will be placed on the role of financial constraints in the market's valuation of the cash held by firms, exploring how the increased financial constraints during the great recession influenced the market value of cash. In particular, this study will focus on the countries which underwent EU intervention during the European sovereign debt crisis, namely Greece, Portugal, Ireland and Spain, whose troubled public finances and banking systems are likely to have severely hindered the access to external capital by firms. This new research will contribute to the literature on financial constraints and their impact on firms.

Study	Geography/ Mean Marginal Value of Cash	Investment Opportunities	Uncertainty of Cash Flows	Uncertainty of Investments	Probability of Distress/ Leverage	Financial Constraints	Quality of Governance/ Investor Protection	Size of Cash Position	Information Asymmetry	Main Supported Theory(ies)
Pinkowitz and Williamson (2005)	US $1.02	+	n.a.	+	-	+/-	n.a.	+/-	n.a.	Trade-off
Pinkowitz and Williamson (2007)	US $1.04	+	+	+	n.a.	n.a.	n.a.	n.a.	n.a.	Pecking Order
Faulkender and Wang (2006)	US $0.94	n.a.	n.a.	n.a.	-	+	n.a.	-	n.a.	Trade-off Free Cash Flow
Pinkowitz et al. (2006)	World n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	+	n.a.	n.a.	Free Cash Flow
Dittmar and Mahrt-Smith (2007)	US $1.09	n.a.	n.a.	n.a.	-*	+	+	+/-*	n.a.	Free Cash Flow
Denis and Sibilkov (2010)	US n.a.	n.a.	n.a.	n.a.	-	+	n.a.	-	n.a.	Trade-off
Drobetz et al. (2010)	World $0.809	n.a.	n.a.	n.a.	n.a.	-	+	n.a.	-	Free Cash Flow

Lee and Powell (2011)	Australia $1.04	n.a.	n.a.	n.a.	-	n.a.	n.a.	-	n.a.	Trade-off Free Cash Flow
Martínez-Sola et al. (2013)	US n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	+/-	n.a.	Trade-off
Chan et al. (2013)	Australia $0.867	+	+	n.a.	-	+	+/-*	-	n.a.	Trade-off
Bates et al. (2017)	US $0.61-$1.12	+	+	n.a.	-	+	+	-	n.a.	Trade-off
Chang et al. (2017)	US n.a.	n.a.	n.a.	n.a.	-*	+/-	+	-*	n.a.	Trade-off

Table 1 - Summary of the main empirical evidence on the market value of cash

This table summarises the results of the studies on the marginal value of cash reviewed in section 2.3. The estimates of the mean marginal value of cash are reported based on change values as opposed to level values when available. "n.a." denotes information that was either not available or not tested in the respective study. "*" identifies variables whose results were not statistically significant.

3. Research Hypotheses

This chapter is aimed at introducing the research hypotheses that will be empirically tested throughout this study. The previously reviewed theoretical motives for holding cash, the three main theories seeking to explain holdings of cash by firms and the available empirical evidence on the market value of cash are the basis for the development of said hypotheses, which establish a prediction of the impact of several variables on the market value of cash for Eurozone firms.

(i) Investment Opportunities

In a world of imperfect markets, where firms have a harder time sourcing capital from external markets, lack of liquidity can compromise value-adding investments when external financing is unfavourable or unavailable (Fazzari et al., 1988; Myers & Majluf, 1984). Therefore, under the precautionary motive, and consistent with both the trade-off and the pecking order theories, firms with better investment opportunities should hold more cash and have it valued more highly. The available empirical evidence on the level of cash (Ferreira & Vilela, 2004; Kim et al., 1998; Lee & Powell, 2011; Opler et al., 1999; Ozkan & Ozkan, 2004), as well as its value (Bates et al., 2017; Chan et al., 2013; Pinkowitz & Williamson, 2007), is largely supportive of this theoretical prediction.

Hypothesis 1 (H1): Companies with better investment opportunities will have a higher value placed on additional units of cash.

(ii) Uncertainty of Cash Flows

Following the precautionary motive for holding cash, and consistent with the trade-off and pecking order theories, firms with more volatile cash flows should hold more valuable cash, since they are more likely to go through periods when their cash flow is insufficient to fund all available positive NPV investment opportunities. Therefore, and considering external financing as a generally costlier alternative to internal financing, holdings of cash will allow these firms to seize those investment opportunities under cash flow shortfalls and when external financing is less attractive.

Han and Qiu (2007), Kim et al. (1998) and Opler et al. (1999) find a positive relationship between the volatility of cash flows and the level of cash held, while Bates et al. (2009) show increasing cash flow volatility has been one of the main drivers of cash balances over the

past decades. Similarly, Bates et al. (2017), Chan et al. (2013) and Pinkowitz and Williamson (2007) find that higher cash flow uncertainty positively impacts the market value of cash, as expected. However, Ferreira and Vilela (2004) observe that EMU companies with more volatile cash flow actually hold less cash, which may be due to these firms having a higher cost of capital and cash being more expensive as a consequence. Overall, we expect the following relation between cash flow volatility and the market value of cash:

Hypothesis 2 (H2): Companies with more volatile cash flows will have a higher value placed on additional units of cash.

(iii) Leverage

Increases in leverage are generally harmful to the debtholders of a firm, whose position becomes less valuable as the return they are receiving is no longer adequate given the level of risk taken. Contrarily, shareholders may benefit from such an increase, given the increased risk-taking leads to higher expected returns. Therefore, and as demonstrated through contingent claim analysis (Black & Scholes, 1973), higher cash holdings only benefit debtholders in this situation, as the decreased risk – through lower net debt – increases the odds of bondholders receiving their capital back while constituting an opportunity cost for shareholders who could benefit from it being profitably invested or distributed. Consequently, we expect shareholders to value cash less the higher the leverage of the firm.

Ferreira and Vilela (2004), Kim et al. (1998), Opler et al. (1999) and Ozkan and Ozkan (2004) report holdings of cash by firms are negatively related with leverage, whilst evidence on the market value of cash also supports the hypothesis that cash has less value in firms with higher leverage (Bates et al., 2017; Chan et al., 2013; Denis & Sibilkov, 2010; Faulkender & Wang, 2006; Lee & Powell, 2011). Therefore, we formulate the following hypothesis:

Hypothesis 3 (H3): Companies with higher leverage will have a lower value placed on additional units of cash.

(iv) Size of Cash Position

The trade-off theory suggests that firms have an optimal level of cash attained when the marginal benefits of cash, driven mainly by the transaction and precautionary motives, equal the marginal costs of cash, the opportunity cost relative to more profitable investments and agency problems - see, for instance, Opler et al. (1999). Provided this theory is correct and

an optimal level of cash exists, we should expect a concave relation between the level of cash and its value, as empirically documented by Martínez-Sola et al. (2013).

Consistent with the free cash flow theory and opposite to the predictions of the pecking order theory, several authors find that higher cash holdings lead to a lower value being placed on marginal cash (Bates et al., 2017; Chan et al., 2013; Denis & Sibilkov, 2010; Faulkender & Wang, 2006; Lee & Powell, 2011), given potential agency problems increase with the level of cash (Jensen, 1986). However, these authors use specifications that do not allow for the detection of a concave relation between the level of cash and its value. Given the theoretical prediction and the empirical evidence, we hypothesize the following:

Hypothesis 4 (H4): There is a concave relation between the level of cash held and the marginal value of cash.

(v) Quality of Corporate Governance and Acquisition Activity

The agency cost of holding cash and, by extension, the free cash flow theory, suggests that firms holding excess cash would tend to waste that cash in value decreasing activities which benefit the management at the expense of the firm's shareholders (Jensen, 1986; Jensen & Meckling, 1976). Authors such as Blanchard et al. (1994), Easterbrook (1984), Harford (1999) and Harford et al. (2008), for instance, find support for that hypothesis.

However, proper corporate governance mechanisms can decrease the agency costs between managers and shareholders by aligning their interests and increasing the discipline and monitoring imposed on managers (Jensen, 1986; Jensen & Meckling, 1976). Consistently, several authors note that firms with better governance tend to waste less cash (Harford et al., 2008) and have their cash valued more highly (Bates et al., 2017; Dittmar & Mahrt-Smith, 2007; Drobetz et al., 2010; Pinkowitz et al., 2006). Therefore, we hypothesize:

Hypothesis 5 (H5): Companies with better corporate governance have a higher value placed on additional units of cash.

One particularly popular destination for excess cash in firms with poor governance mechanisms in place is acquisitions, with Jensen (1986) arguing that acquisitions are one way self-interested managers can waste cash instead of paying it out. Harford (1999) and Harford et al. (2008), for instance, find that cash-rich firms are more likely to do acquisitions, destroying shareholder value. Similarly, Blanchard et al. (1994) report that firms with poor

investment opportunities tend to retain cash from windfalls to later use it in acquisition activity. These studies suggest that acquisition activity, when viewed as an often value-destroying activity, could be reflected in a lower marginal value of cash, since such cash is more likely to be used for inorganic growth with doubtful value creation potential as opposed to organic growth through profitable investment opportunities.

Overall, the literature is suggestive of a negative relation between acquisition activity and the marginal value of cash:

Hypothesis 6 (H6): Companies with higher acquisition activity have a lower value placed on additional units of cash.

The impact of acquisition activity on the marginal value of cash may, however, be dependent on the quality of the firm's corporate governance structure. Dittmar and Mahrt-Smith (2007) and Harford et al. (2008), for instance, find that poorly governed firms are more likely to spend excess cash on acquisitions when compared to well-governed firms.

Considering the possibility that acquisition activity is value destroying only when firms are poorly governed, given that well-governed firms will have a lower tendency to waste cash, we hypothesize:

Hypothesis 6.1 (H6.1): Recent acquisition activity will have a negative impact on the marginal value of cash for firms with poor governance.

Hypothesis 6.2 (H6.2): Recent acquisition activity will have a positive or neutral impact on the marginal value of cash for firms with good governance.

(vi) Degree of Financial Constraints and Financial Crisis

As previously discussed, holdings of cash and active decisions related to cash management policies are only relevant in a setting of imperfect markets where any external financing required may not be promptly available and affordable (Fazzari et al., 1988; Myers & Majluf, 1984; Opler et al., 1999), becoming more relevant the more constrained firms are as far as external financing is concerned. Therefore, and according to the precautionary motive and trade-off and pecking order theories, cash should be more valuable in firms that face the highest difficulties when raising capital.

The support for the impact of financial constraints on the size and value of cash holdings is plentiful. Almeida et al. (2004) find that unlike unconstrained firms, constrained ones tend to accumulate cash from cash flow, in order to be better positioned to face future cash flow shortages. Han and Qiu (2007) extend the model of Almeida et al. (2004) by incorporating cash flow volatility in addition to the cash flow level, finding that while cash holdings of unconstrained firms are not related to cash flow volatility, those of constrained firms are sensitive to it, increasing as volatility increases. Additionally, the value of cash in constrained companies is generally found to be greater than that of unconstrained firms (Bates et al., 2017; Chan et al., 2013; Chang et al., 2017; Denis & Sibilkov, 2010; Dittmar & Mahrt-Smith, 2007; Faulkender & Wang, 2006), given that the investment in positive NPV investment opportunities of the former is more dependent on cash than that of the latter (Denis & Sibilkov, 2010). Following theory and evidence, we hypothesize:

Hypothesis 7 (H7): Companies facing higher financial constraints have a higher value placed on additional units of cash.

The recent period of crisis at a worldwide level resulted in greatly increased financial constraints, as the consequence of a plunging supply of credit by financial institutions and capital markets as a reaction to the economic turmoil. This increased difficulty in accessing external capital should increase the value placed on cash during this period of tight credit, since firms with more cash should be in a better position to meet their obligations and continue investing when compared to firms with low cash reserves, as confirmed by Campello et al. (2010) and Duchin et al. (2010). Bates et al. (2017) find that the increase in the value of cash during the 2000s was largely due to increased financial constraints, measured through the spread charged on BBB bonds over AAA bonds, resulting from the two recessions which market the period and the subsequent economic and market instability.

Therefore, we hypothesize that the marginal value of cash of Eurozone firms was, on average, higher during the period of the European sovereign debt crisis, particularly for firms in the most affected countries.

Hypothesis 8 (H8): The average marginal value placed on cash was greater during the period of the European sovereign debt crisis.

Hypothesis 9 (H9): The average marginal value placed on cash was greater for firms located in those countries that underwent EU intervention.

4. Methodology and Data

4.1. Methodology

The literature on the market value of cash resorts to two different specifications when attempting to estimate the market value of cash and empirically test hypotheses.

The first, initially used by Pinkowitz and Williamson (2005) and Pinkowitz and Williamson (2007) and later used by Bates et al. (2017), Dittmar and Mahrt-Smith (2007), Drobetz and Grüninger (2007) and Pinkowitz et al. (2006), adapts the valuation regression developed by Fama and French (1998) by splitting the independent variable corresponding to the change in assets in change in cash and non-cash assets to isolate the value placed on cash only. The model is estimated using the approach of Fama and Macbeth (1973), which involves running yearly cross-sectional regressions and using the mean of the cross-sectional regressions to make inferences, in order to mitigate the limitations noted by Fama and French (1998).

The second approach, initially employed by Faulkender and Wang (2006) and later also used by Bates et al. (2017), Chan et al. (2013), Chang et al. (2017), Denis and Sibilkov (2010), Dittmar and Mahrt-Smith (2007) and Lee and Powell (2011), uses excess returns over 25 Fama and French (1993) benchmark portfolios formed on size and book-to-market (BtM) ratio as the dependent variable as opposed to the market-to-book (MtB) ratio used in the previous approach. This method is similar in nature to an event study, since excess returns are used to assess the impact of an event – the unexpected change in cash holdings, in this case – through a specific event window – the fiscal year.

Both approaches allow for a direct interpretation of the coefficient on the change in cash as the marginal value of a dollar of cash, since both dependent and independent variables are standardized by the same metric - book value of assets, in the case of Pinkowitz and Williamson (2005), and market value of equity, in the case of Faulkender and Wang (2006). However, the literature points to some advantages of the second approach over the first, namely the fact that the first method does not allow for changes in the discount rate – resulting from time-varying pricing of risk - of the firms over time, whilst the second does. In addition, Faulkender and Wang (2006) note that accounting differences when measuring the book value of assets relative to the true replacement cost of those assets can explain part of the variability in the MtB ratio and bias the estimates of the value of cash, while Whited and Wu (2006) claim the second approach is more appropriate to assess the impact of

financial constraints on the value of cash because financial constraints appear to be a priced risk factor, therefore impacting the discount rate.

For these reasons, we later estimate the first model as a robustness test, but our base empirical model follows the approach of Faulkender and Wang (2006)[2]:

$$r_{i,t} - R_{i,t} = \alpha_0 + \beta_1 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \beta_2 \frac{\Delta E_{i,t}}{M_{i,t-1}} + \beta_3 \frac{\Delta NA_{i,t}}{M_{i,t-1}} + \beta_4 \frac{\Delta RD_{i,t}}{M_{i,t-1}} + \beta_5 \frac{\Delta I_{i,t}}{M_{i,t-1}} + \beta_6 \frac{\Delta D_{i,t}}{M_{i,t-1}} + \beta_7 \frac{C_{i,t-1}}{M_{i,t-1}} + \beta_8 L_{i,t} + \beta_9 \frac{NF_{i,t}}{M_{i,t-1}} + \beta_{10} \frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \beta_{11} L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \varepsilon_{i,t} \quad (4.1)$$

where *i* denotes the individual companies, *t* denotes the fiscal year and $\varepsilon_{i,t}$ denotes the residual term.

The coefficient estimate for the change in cash - β_1 - in this base model can be interpreted as the marginal value of cash – the euro change in equity value for each euro change in cash holdings, since both dependent and independent variables are standardised by the lagged market value of equity. However, a correct interpretation of such coefficient is dependent on the inclusion of all relevant variables explanatory of firm value in the specification. Bates et al. (2017) address endogeneity concerns in the base model of Faulkender and Wang (2006) under the form of an omitted correlated variable, but find little to no support for such endogenous relationships, thereby rendering a significant omitted variable bias unlikely.

It is worthwhile noting that some authors, such as Chang et al. (2017) and Faulkender and Wang (2006), use only the truly unexpected change in cash as the main independent variable, estimated using the approach of Almeida et al. (2004), under the assumption that expected changes in cash would have been incorporated at the beginning of the year firm value already and should, therefore, have no impact on such value. However, Faulkender and Wang (2006) initially use the total change in cash as the unexpected change in cash, assuming a zero expected change in cash, and report very similar results between the two approaches, concluding results using the total change in cash appear unbiased. Therefore, we will consider the total change in cash to be the unexpected change in cash.

[2] Multicollinearity tests are available for both models in appendix A.

The detailed description of both the dependent and independent variables of this base model can be found in the following sections. The main hypotheses will be tested by interacting dummy variables with the change in cash to assess their impact on the value of cash.

We rely on unbalanced panel data for this dissertation, since our study is focused on both time series and cross-sectional effects. Panel data has been increasingly used by academics due to its advantages relative to exclusively time series or cross-sectional data, namely the improved efficiency of estimates – resulting from more degrees of freedom and less collinearity among regressors – and the ability to study certain research questions not susceptible to be studied via the two alternative data sets (Hsiao, 2014).

Regarding model estimation, Petersen (2009) and Thompson (2011) argue that the failure to account for the dependence in the residuals across firms and/or time in finance panel data sets often leads to biased standard errors which underestimate the true standard errors and lead to deceptively large t-statistics. Given the resemblance of our model with the asset pricing literature, where returns are the dependent variable, we expect some cross-sectional dependence to be present, since market-wide shocks can affect multiple firms' returns simultaneously. Following Petersen (2009), we find that unlike standard errors clustered by firm, those clustered by time exceed White (1980) standard errors by an average factor of 1.5 times, which is suggestive of the presence of some time effects. Consequently, and consistently with recent literature attempting to identify the best panel data estimators for hypothesis testing (Moundigbaye, Rea, & Reed, 2018; Reed & Ye, 2011), we estimate panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence (clustered by time).

For comparison purposes with Faulkender and Wang (2006) and the following literature, we estimate pooled OLS models. We later test our hypotheses using firm fixed effects models as a robustness test (section 5.4).

4.2. Variables

(i) Dependent Variable

Following Faulkender and Wang (2006), the dependent variable is the excess return of the stock over the benchmark ($r_{i,t}$ - $R_{i,t}$), which is comprised of the 25 Fama and French (1993)

European value-weighted portfolios formed on size and BtM ratio. This approach is used because Fama and French (1993) find that size and BtM ratio constitute good proxies for risk factors that can explain stock returns. Therefore, different stocks with different size and BtM ratio can exhibit different risk profiles and, consequently, different expected returns.

Each firm is sorted by size and BtM ratio and fitted into its respective portfolio, whose return is a value-weighted return based on market capitalization. The data used for both stock and benchmark returns is annual data.

(ii) Main Independent Variables

The independent variables are the same used by Faulkender and Wang (2006) and include control variables for changes in profitability and in financing and investment policy:

1. Change in cash (ΔC_t) – Corresponds to the 1-year change in holdings of cash and marketable securities.
2. Lagged cash (C_{t-1}) – Corresponds to the holdings of cash and marketable securities as of the end of the previous fiscal year.
3. Change in earnings (ΔE_t) – Calculated as the 1-year change in earnings, where net income is used as our earnings metric.
4. Change in net assets (ΔNA_t) – Computed as the 1-year change in net assets, with net assets being equal to total assets minus cash and marketable securities.
5. Change in R&D (ΔRD_t) – Corresponds to the 1-year change in R&D expenditures. If R&D expenditures are missing, the variable is set to zero, in accordance with the literature that follows the model of Faulkender and Wang (2006).
6. Change in interest expense (ΔI_t) - Calculated as the 1-year change in interest expenses.
7. Change in dividends paid (ΔD_t) – Computed as the change in common dividends paid.
8. Leverage (L_t) – The leverage ratio is computed as the ratio between total debt and the sum of total debt and market value of equity.
9. Net financing (NF_t) – Net financing corresponds to net financing cash flow excluding dividend payments.

Faulkender and Wang (2006) also include the interaction between lagged cash (C_{t-1}) and leverage (L_t) – hypothesis H3 - and the change in cash (ΔC_t), to assess how the marginal value of cash changes with leverage and cash levels. However, this specification assumes a linear interaction between the marginal value of cash and lagged cash, which may not be the

case if an optimal level of cash, supported by some of the literature, exists. Therefore, we also include the squared lagged cash (C_{t-1}^2) as an interaction term in an alternative specification, allowing us to test hypothesis H4.

10. Interaction of lagged cash with the change in cash ($C_{t-1}*\Delta C_t$ and $C_{t-1}^2*\Delta C_t$).
11. Interaction of leverage with the change in cash ($L_t*\Delta C_t$).

All independent variables, with the exception of leverage (L_t), are deflated by the lagged market value of equity (M_{t-1}) which corresponds to the number of shares multiplied by the closing price at the fiscal-year end (Faulkender & Wang, 2006).

(iii) Dummy Variables

In order to empirically test most of our hypotheses we will resort to dummy variables either added to the main specification or interacted with the change in the value of cash.

a. *Investment Opportunities*

The market-to-book (MtB) ratio, defined as the market value of assets – proxied as the sum of the market value of equity and book value of debt – divided by the book value of assets, is used as the proxy for investment opportunities. Several authors in the literature on both the determinants - see, for instance, Ferreira and Vilela (2004), Kim et al. (1998) and Opler et al. (1999) – and the value of cash holdings (Bates et al., 2017; Chan et al., 2013) use this ratio to proxy investment opportunities, given that relation between the market value and the book value of assets reflects both the already taken and the expected available positive NPV investment opportunities.

A value of 1 for this dummy variable will represent firms with the best investment opportunities (top tercile of the distribution of MtB ratios), whereas a value of 0 will denote those firms with the poorest investment opportunities (lowest tercile of the distribution).

12. Interaction of investment opportunities with the change in cash ($IO_t*\Delta C_t$).

b. *Uncertainty of Cash Flows*

The uncertainty of cash flows is usually proxied by the volatility of a return on capital ratio - see, for instance, Bates et al. (2017), Chan et al. (2013), Kim et al. (1998), Opler et al. (1999) and Pinkowitz and Williamson (2007). We will use that standard deviation in the Net

Income/Book Value of Equity ratio as our proxy for the uncertainty of cash flows, computing it across the 12 years of our sample.

A value of 1 will be assigned to those firms in the top tercile of the distribution of cash flow volatility, while those in the bottom tercile will be assigned a value of 0.

13. Interaction of the uncertainty of cash flows with the change in cash ($UCF_t*\Delta C_t$).

c. *Quality of Corporate Governance and Acquisition Activity*

The proxies used in the literature for the quality of governance vary greatly, which is partly due to the wide range of often interchangeable mechanisms that can be used to mitigate agency problems in firms. Indeed, different firms can employ different combinations of disciplinary mechanisms with equivalent degrees of effectiveness, resulting in very different corporate governance structures (Farinha, 2003; Shleifer & Vishny, 1997). Consequently, we opt for using a composite indicator of the quality of corporate governance, as opposed to a few select indicators commonly used in the literature. Our measure, a relative corporate governance score, belongs to Thomson Reuters' Asset 4 ESG indicators and comprises 68 different corporate governance measures belonging to five different categories: board structure, compensation policy, board functions, shareholder rights and vision and strategy. Firms in the top tercile of the distribution of the scores are classified as having the best governance and are coded as 1, while firms in the bottom tercile are coded as 0.

14. Interaction of the quality of corporate governance with the change in cash ($CG_t *\Delta C_t$).

Hypotheses H6, H6.1 and H6.2 will be tested through a further dummy variable splitting the firms between those in the bottom ($ACQ_t=0$) and top tercile of acquisition activity ($ACQ_t=1$), proxied by the average Acquisitions/Book Value of Assets ratio over the 12 years.

15. Interaction of acquisition activity with the change in cash ($ACQ_t*\Delta C_t$).
16. Interaction of acquisition activity with the quality of corporate governance and the change in cash ($ACQ_t*CG_t*\Delta C_t$)

d. *Degree of Financial Constraints and Financial Crisis*

Several variables and indexes have been used in the literature to proxy the degree of financial constraints faced by firms, with the most used approaches being those of Almeida et al. (2004), Hadlock and Pierce (2010) and Whited and Wu (2006). The approach of Almeida et

al. (2004), which uses the payout ratio, firm size and bond and commercial paper ratings as the four proxies for financial constraints, is the most often used in the literature addressing the value of cash (Bates et al., 2017; Chang et al., 2017; Denis & Sibilkov, 2010; Faulkender & Wang, 2006; Pinkowitz & Williamson, 2005). However, Hadlock and Pierce (2010) find that firm size and age best match qualitative information signalling potential financial constraints, with most variables and indexes used by these and other authors losing significance when their two proxies are controlled for. The main premise behind the relevance of firm size and age as proxies for the degree of financial constraint pertains to the increased information asymmetries the providers of external finance face when dealing with smaller and younger companies (Carreira & Silva, 2010), which results in harder access to external funds by those firms. Therefore, we will use both size and age[3] to classify firms as unconstrained (top tercile of the size or age distribution and assigned a value of 1) and constrained (bottom tercile of the size or age distribution and assigned a value of 0), allowing us to test hypothesis H7.

17. Interaction of firm size and age with the change in cash ($SIZE_t*\Delta C_t$ and $AGE_t*\Delta C_t$).

Given that some hypotheses require a distinction between the period of the European sovereign debt crisis and other periods, as well a distinction between firms located in those countries which underwent EU intervention, namely Greece, Portugal, Ireland and Spain, and the other Eurozone countries, we use three different dummy variables interacted with the change in cash. The first dummy (CC_t) takes the value of 1 if the firm is headquartered in the aforementioned countries, 0 otherwise; the second dummy (CY_t) takes the value of 1 for observations belonging to the period of the crisis, 0 otherwise; the third dummy (CCY_t) aggregates both countries and time periods by labelling any observation belonging to a country which was subject to a bailout program and to the time period the country was under intervention as 1, 0 otherwise[4]. Lastly, we include a fourth interaction variable ($YIELD_t$) comprised of the yearly change in the yield of 10-year government bonds of each Eurozone country, given we consider that the yield on these bonds can be a good proxy for the

[3] Following Hadlock and Pierce (2010), size is defined as the book value of assets. However, given that we do not have access to data regarding the listing year of the companies in our database, which is the base year for the authors' computation of a given firm's age, we use the year the company was founded as our base year.

[4] According to the European Commission (European Commission, 2017), Greece, Portugal, Ireland and Spain were under financial assistance between 2010-today, 2011-2014, 2010-2013 and 2012-2013, respectively.

perceived risk of any given country by the financial markets and, by extension, of the degree of financial constraint faced by the firms in those countries.

The period of the European sovereign debt crisis considered for the purposes of the second dummy variable is 2008-2013. This crisis is often considered to have started in 2008, with the Irish banks' bailouts, and intensified further during August-September of 2011 (Beirne & Fratzscher, 2013). However, access to capital markets by Spain, Ireland and Portugal – some of the most affected countries - was only restored at the beginning of 2013, hence we considering this the last year of the most critical period of the crisis.

Therefore, hypotheses H8 and H9 will be tested in the following ways:

18. Interaction of the dummy signalling the countries which underwent EU intervention with the change in cash ($CC_t * \Delta C_t$).
19. Interaction of the dummy signalling the crisis period with the change in cash ($CY_t * \Delta C_t$).
20. Interaction of the dummy aggregating both the period of the crisis and the most affected countries with the change in cash ($CCY_t * \Delta C_t$).
21. Interaction of the change in 10-year government bond yields with the change in cash ($YIELD_t * \Delta C_t$).

4.3. Data and Sample

For this study, we use a sample of publicly traded firms from 12 Eurozone countries (those that were already adherent of the Euro at the start year of our sample – Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) and collect data from 2005 to 2016. Firms in the financial services, utilities, real estate investment trusts (REIT) and unclassified sectors are excluded. Furthermore, firm-year observations with missing data for any of the variables required for our base model are eliminated. The resulting base model sample is comprised of 2648 individual firms - including both survivors and non-survivors as to avoid survivorship bias - and 18649 firm-year observations. The data were retrieved from the *Datastream* database. All variables are winsorized at the 1st and 99th percentiles, following most of the reviewed literature and reducing the impact of extreme observations.

Table 2 presents the descriptive statistics for the variables of our base model.

Table 2 - Descriptive statistics

Variable	Mean	Min	25th Percentile	Median	75th Percentile	Max	Std. Dev.	N
$r_{i,t} - R_{i,t}$	0.018	-0.869	-0.257	-0.029	0.221	1.813	0.442	18649
ΔC_t	0.014	-0.650	-0.025	0.002	0.042	0.847	0.172	18649
C_{t-1}	0,196	0.000	0.034	0.097	0.226	1.851	0.293	18649
ΔE_t	0.024	-1.437	-0.034	0.005	0.042	2.181	0.369	18649
ΔNA_t	-0.019	-4.228	-0.100	0.031	0.169	2.950	0.782	18649
ΔRD_t	0.000	-0.064	0.000	0.000	0.000	0.053	0.011	18649
ΔI_t	-0.002	-0.214	-0.004	0.000	0.004	0.127	0.035	18649
ΔD_t	-0.001	-0.139	0.000	0.000	0.003	0.096	0.026	18649
L_t	0.328	0.000	0.102	0.278	0.512	0.959	0.263	18649
NF_t	0.029	-1.080	-0.050	0.000	0.077	1.494	0.294	18649

This table presents the descriptive statistics of the variables in our base model sample of 18649 firm-years from 2648 firms listed in 12 Eurozone countries, over the period 2005 to 2016. All variables were retrieved from the *Datastream* database and are winsorized at the 1st and 99th percentiles. $r_{i,t} - R_{i,t}$ is the stock's excess return, computed as the difference between the annual stock return of firm *i* at time *t* and the stock's benchmark portfolio return at time *t*. C_t is cash and marketable securities; Et is net income; NA_t is total assets minus cash and marketable securities; RDt is R&D expenditures, set to 0 if missing; It is interest expenses; D_t is dividend payments; Lt is market leverage, measured as book debt divided by book debt plus market equity; NFt is net financing, defined as net financing cash flow excluding dividend payments. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All variables barring Lt and $ri,t - Ri,t$ are deflated by the lagged market value of equity.

These statistics are very similar in sign and magnitude to those reported by authors which follow the same methodology, such as Chan et al. (2013), Chang et al. (2017) and Faulkender and Wang (2006). At 19.6% and 9.7%, respectively, the mean and median levels of cash holdings as a percentage of market value of equity of our sample are higher than those observed by Faulkender and Wang (2006) for the US between 1972 and 2001 (17.3% and 9.5%, respectively), and by Chan et al. (2013) for Australia between 1990 and 2007 (11.8% and 5.5%, respectively). However, these levels are lower than those documented for the US from 2002 to 2010, of 21.4% and 12.8%, respectively (Chang et al., 2017). The positive mean and median values for the change in cash suggest that cash ratios increased throughout the period, consistent with evidence by Bates et al. (2009) and Graham and Leary (2017). Regarding leverage, the 32.8% mean market debt ratio for the Eurozone firms in our sample is higher than that reported by the other authors for the US - 22.7% (Faulkender & Wang, 2006) - and Australia - 19.4% (Chan et al., 2013).

5. Results and Discussion

5.1. Base Model

We start our empirical analysis by estimating the base model of Faulkender and Wang (2006), from equation 4.1, both through pooled OLS and firm fixed effects, for comparison purposes (table 3).

Table 3 - Estimation output of the base model

Independent Variables	I	II	III
Intercept	0.084*** (0.026)	0.194*** (0.040)	0.083*** (0.026)
ΔC_t	0.646*** (0.047)	0.742*** (0.050)	0.683*** (0.060)
ΔE_t	0.118*** (0.015)	0.104*** (0.013)	0.118*** (0.015)
ΔNA_t	0.074*** (0.009)	0.050*** (0.008)	0.075*** (0.009)
ΔRD_t	0.273 (0.381)	-0.170 (0.348)	0.284 (0.380)
ΔI_t	-0.154 (0.145)	0.119 (0.156)	-0.158 (0.145)
ΔD_t	0.854*** (0.272)	0.578** (0.240)	0.854*** (0.272)
C_{t-1}	0.248*** (0.047)	0.555*** (0.051)	0.250*** (0.040)
L_t	-0.372*** (0.048)	-0.896*** (0.103)	-0.372*** (0.048)
NF_t	-0.072*** (0.022)	-0.030 (0.019)	-0.072*** (0.022)
$C_{t-1}*\Delta C_t$	-0.132*** (0.041)	-0.156*** (0.042)	-0.279** (0.130)
$L_t*\Delta C_t$	-0.357*** (0.041)	-0.337*** (0.078)	-0.364*** (0.072)
$C_{t-1}^2*\Delta C_t$	-	-	0.079 (0.069)
Observations	18649	18649	18649
Adjusted R^2	0.114	0.179	0.114
F-Statistic	218.25	2.53	200.22

This table presents the estimation output of the base model (equation 4.1) through pooled OLS (I), firm fixed effects (II) and pooled OLS with an additional quadratic term for the interaction between the change in cash and lagged cash (III). The independent variables are regressed against the excess return of any given stock over the benchmark throughout a given fiscal year. *Ct* is cash and marketable securities; *Et* is net income; *NAt* is total assets minus cash and marketable securities; *RDt* is R&D expenditures, set to 0 if missing; *It* is interest expenses; *Dt* is dividend payments; *Lt* is market leverage, measured as book debt divided by book debt plus market equity; *NFt* is net financing, defined as net financing cash flow excluding dividend payments. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All variables barring *Lt* and the dependent variable are deflated by the lagged market value of equity. All variables are winsorized at the 1st and 99th percentiles. Panel-corrected

standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

The results for the pooled OLS model and firm fixed effects model are, as previously mentioned, very similar as far as sign, magnitude and significance are concerned, which leads us to favour the former over the latter henceforth as to maintain flexibility when testing hypotheses with time-invariant variables and for comparison purposes with the original, pooled OLS based literature. We later estimate firm fixed effect models for the coming specifications as well (section 5.4). The signs and magnitudes obtained in our estimation are largely consistent with those obtained by Faulkender and Wang (2006) and the related literature and only the change in R&D and change in interest expenses differ from these in significance.

Our results suggest that the average firm in our sample has an extra euro in cash valued by the market at only €0.503, based on an average cash ratio of 19.6% and an average leverage ratio of 32.8% (€0.503 = 0.646 – 0.132*0.196 – 0.357*0.328). This result is considerably lower than those achieved by most other authors, which tend to be closer to unity for the US (see table 1). Faulkender and Wang (2006) argue their below unity estimate of the marginal value of cash - $0.94 – is consistent with their hypothesis that shareholders value the cash retained by firms discounting for the tax paid upon its distribution. However, tax rates on dividends in the Eurozone were similar to those in the US throughout the period, failing to account for the discrepancy. This hypothesis is also inconsistent with the results of the studies which estimate a marginal value of cash above unity (Dittmar & Mahrt-Smith, 2007; Lee & Powell, 2011; Pinkowitz & Williamson, 2005, 2007).

Nonetheless, authors exploring the value of cash outside of the US do tend to observe lower marginal values of cash for countries other than the US. For instance, Drobetz et al. (2010) report a marginal value of cash for countries outside of the US of $0.552 - versus $0.809 in the US, which is remarkably close to our estimate. Pinkowitz et al. (2006) find that the marginal value of cash differs considerably between more developed countries with better investor protection and less developed countries with worse investor protection, but the differences in development and institutional quality between Eurozone countries and the US are marginal, according to their own metrics. Finally, we rule out the hypothesis that the specificities of our test period, market by the financial crisis of 2008, could have significantly

influenced this estimate, since statistical evidence does not support significantly different coefficients between crisis and non-crisis periods (table 6).

This estimation also allows for conclusions pertaining to hypotheses H3 and H4.

The negative and statistically significant (at the 0.01 level) estimated coefficients on the interaction between leverage and lagged cash levels with the change in cash are consistent with the findings of Bates et al. (2017), Chan et al. (2013), Denis and Sibilkov (2010), Faulkender and Wang (2006), Lee and Powell (2011) and Pinkowitz and Williamson (2005). The negative effect of leverage on the marginal value of cash empirically supports hypothesis H3, which postulates that firms with higher leverage have a lower value placed on their marginal cash since that additional cash accrues to the bondholders exclusively, by reducing default risk, the more the higher the leverage. These results contradict the hypothesis that leverage can be valuable from an agency cost perspective by decreasing free cash flow and increasing the discipline and monitoring imposed on firm managers (Jensen, 1986).

In contrast, our findings for the relationship between cash levels and the marginal value of cash are out of line with hypothesis H4. The estimated coefficient on the interaction between the squared lagged value of cash (estimation output III) and the change in cash is not significant at the 0.10 level, which suggests that the hypothesized concave relation between the level of cash and the marginal value of cash is not supported by statistical evidence. Furthermore, the signs of the estimated coefficients are opposite to what would be expected if the marginal value of cash increased with the level of cash until the optimal level of cash was reached, decreasing from then on, where we would expect to find a positive sign on the lagged value of cash and a negative sign on the squared lagged value of cash. Summarily, our findings contradict the hypothesis that an optimal level of cash exists for each firm, as proposed by the trade-off theory and empirically verified by authors such as Martínez-Sola et al. (2013)[5]. Instead, our results are suggestive of a linear, negative relation between levels of cash and its marginal value, with firms with higher values of cash commanding a lower value on additional units of cash. This evidence is most consistent with the free cash flow theory of Jensen (1986), whereby firms with higher levels of cash are less likely to be

[5] It is worth noting that Martínez-Sola et al. (2013) use a different specification, using the MtB ratio as dependent variable, as well as a different estimation method, the generalized method of moments (GMM). They also employ several different models to add robustness to their conclusions.

constrained and more likely to waste cash in value-destroying activities, and contradicts the pecking order theory (Myers, 1984; Myers & Majluf, 1984), according to which firms accumulate as much cash as possible to avoid the costs in raising external finance.

Lastly, we estimate the base model – leaving out the interactions between leverage and lagged cash and the change in cash, for ease of computation of interval estimates, which we also report - for each of the 33 industries and 12 countries in our sample, aiming to discern the differences in the market valuation of cash between industries and countries. Our estimation results are available in appendices B and C. We draw attention for the large standard errors associated with some estimations, especially those for industries and countries with fewer observations, which produce large interval estimates for a 95% confidence interval.

Regarding industries, we note that industries with less volatile businesses and/or worse growth opportunities, such as those related to retail, telecommunications, food and beverages, tend to register estimates on the value of cash below sample average. In contrast, firms operating in more dynamic, volatile industries are associated with higher marginal values of cash. Particularly, R&D intensive industries, such as pharmaceuticals and biotechnology – the top-ranking industry according to our estimates, with a marginal value of cash more than double the sample average – as well as hardware and software, stand out. This preliminary analysis appears supportive of our hypotheses that firms with better investment opportunities, more volatile businesses and harder access to external financing – considering information asymmetries are often higher for R&D intensive firms (Opler et al., 1999) – draw more value from retaining cash. Our ranking of industries by marginal value of cash is also similar to that reported by Pinkowitz and Williamson (2007)for US firms.

As far as countries go, there is also a significant disparity between the estimate of the marginal value of cash between Eurozone countries. However, these initial results appear to contradict some of our hypotheses pertaining to the effects of the crisis, since firms in some of the most affected countries – namely Portugal and Greece – register some of the lowest marginal values of cash, as opposed to highest.

These first observations will be subject to more detailed statistical analysis in the following sections.

5.2. Investment Opportunities, Uncertainty of Cash Flows, Quality of Corporate Governance and Acquisition Activity

We follow our base model estimation with models interacting dummy variables – separating firms according to the quality of their investment opportunities, degree of cash flow uncertainty, quality of corporate governance and acquisition activity, to test hypotheses H1, H2, H5 and H6, respectively – with the change in cash, seeking to understand how certain firm characteristics influence the marginal value placed on cash (table 4).

Table 4 - Estimation output of the base model with interactions for the investment opportunities, degree of cash flow uncertainty, quality of corporate governance and acquisition activity

Independent Variables	Investment Opportunities	Uncertainty of Cash Flows	Quality of Corporate Governance	Acquisition Activity
Intercept	-0.057** (0.028)	0.099*** (0.029)	0.127*** (0.032)	0.078*** (0.025)
ΔC_t	0.562*** (0.057)	0.503*** (0.062)	0.850*** (0.150)	0.585*** (0.050)
ΔE_t	0.093*** (0.014)	0.107*** (0.015)	0.350*** (0.075)	0.118*** (0.015)
ΔNA_t	0.079*** (0.009)	0.063*** (0.009)	0.091*** (0.022)	0.068*** (0.009)
ΔRD_t	0.571 (0.409)	0.309 (0.434)	-0.304 (0.968)	0.010 (0.404)
ΔI_t	-0.271* (0.153)	-0.035 (0.144)	-0.515 (0.611)	-0.181 (0.262)
ΔD_t	0.809*** (0.213)	0.883** (0.273)	-0.734* (0.444)	0.942*** (0.262)
C_{t-1}	0.255*** (0.034)	0.274*** (0.041)	0.319*** (0.0.064)	0.247*** (0.038)
L_t	-0.230*** (0.034)	-0.346*** (0.044)	-0.451*** (0.083)	-0.376*** (0.045)
NF_t	-0.107*** (0.020)	-0.034* (0.020)	-0.079 (0.062)	-0.064*** (0.022)
$C_{t-1}*\Delta C_t$	-0.084* (0.043)	-0.142** (0.060)	0.060 (0.160)	-0.127*** (0.046)
$L_t*\Delta C_t$	-0.325*** (0.084)	-0.301*** (0.088)	-0.473 (0.304)	-0.343*** (0.076)
IO_t	0.179*** (0.023)	-	-	-
$IO_t*\Delta C_t$	0.286*** (0.064)	-	-	-
UCF_t	-	-0.076*** (0.019)	-	-
$UCF_t*\Delta C_t$	-	0.159*** (0.058)	-	-
CG_t	-	-	0.024* (0.013)	-

$CG_t * \Delta C_t$	-	-	-0.404*** (0.147)	-
ACQ_t	-	-	-	0.025* (0.013)
$ACQ_t * \Delta C_t$	-	-	-	0.139*** (0.047)
Observations	12304	11977	2437	15531
Adjusted R^2	0.153	0.125	0.150	0.111
F-Statistic	171.56	132.46	34.19	150.72

This table presents the estimation output of the models interacting the investment opportunities, uncertainty of cash flows, quality of corporate governance and acquisition activity with the change in cash. The independent variables are regressed against the excess return of any given stock over the benchmark throughout a given fiscal year. C_t is cash and marketable securities; Et is net income; NA_t is total assets minus cash and marketable securities; RDt is R&D expenditures, set to 0 if missing; It is interest expenses; D_t is dividend payments; Lt is market leverage, measured as book debt divided by book debt plus market equity; NFt is net financing, defined as net financing cash flow excluding dividend payments. IO_t, UCF_t, CG_t and ACQ_t are dummy variables dividing the sample into the top and bottom terciles of investment opportunities, uncertainty of cash flows, quality of corporate governance and acquisition activity, respectively. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All variables barring Lt, the dependent variable and the dummy variables are deflated by the lagged market value of equity. All continuous variables are winsorized at the 1st and 99th percentiles. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

According to our estimation, the four variables under study are significant at the 0.01 level.

The relevance of the quality of the available investment opportunities (H1) for the valuation of cash is substantiated by our estimation, which suggests that each additional euro of cash is worth, on average, €0.286 more for firms in the top tercile of MtB ratio relative to firms in the bottom tercile of the distribution – a total average value of €0.703 versus €0.407, or 70% more. This result is largely consistent with those of the reviewed literature, which all finds ample statistical evidence supporting this hypothesis, both for the US (Bates et al., 2017; Pinkowitz & Williamson, 2005, 2007) and Australia (Chan et al., 2013). The additional value placed on cash backing good investment opportunities is supportive of the precautionary motive for holding cash, whereby firms with profitable investment opportunities hold cash to decrease the probability of being unable to finance them, and of the trade-off and pecking order theories, which propose that the marginal benefits of holding cash associated with the precautionary motive are relevant when deciding on cash management policies.

The results obtained for the uncertainty of cash flows are equally supportive of our hypothesis H2. The coefficient on the interaction between the tercile of cash flow volatility

and the change in cash is positive, which is consistent with a higher marginal value of cash for firms with more volatile cash flows. This value is €0.159 higher for firms in the top tercile of cash flow volatility relative to those in the bottom tercile – or 43% higher, when comparing the average marginal value of cash of €0.533 of the former with the €0.374 of the latter. The observed results are in line with those obtained by Bates et al. (2017), Chan et al. (2013) and Pinkowitz and Williamson (2007). Additionally, they are consistent with the precautionary motive for holding cash as well as the adjacent trade-off and pecking order theories, given companies with more volatile cash flows are more likely to go through periods of time when their cash flow is insufficient to cover their investment and debt service needs.

Our findings for the impact of the quality of governance on the marginal value of cash are opposite of what was hypothesized (H5), since we expected well-governed firms to manage cash balances in a more efficient and value adding way, therefore commanding a premium on the value of cash relative to poorly governed firms. Indeed, the negative sign on the coefficient suggests that an additional euro in cash is worth €0.404 less for the best-governed firms when compared to the worst governed firms. This evidence is inconsistent with the findings of most of the literature (Bates et al., 2017; Chang et al., 2017; Dittmar & Mahrt-Smith, 2007; Drobetz et al., 2010; Pinkowitz et al., 2006).[6]

Some of the difference in results may be due to the proxy used for the quality of corporate governance, the composite Asset 4 ESG score from Thompson Reuters, which is largely different from the individual proxies commonly used in the literature, such as the presence of large blocks of ownership (Bates et al., 2017; Chan et al., 2013; Dittmar & Mahrt-Smith, 2007), the presence of institutional investors (Bates et al., 2017; Dittmar & Mahrt-Smith, 2007) and insider ownership (Drobetz et al., 2010). Initially, one may expect a composite proxy for the quality of governance to better and more reliably characterize such quality than individual metrics, leading to more robust results, but such effectiveness is largely dependent on how well that proxy can account for the interchangeability between the different disciplinary mechanisms (Farinha, 2003; Shleifer & Vishny, 1997), since different corporate governance structures can be equally successful. Another potential source of divergence arises from the relative nature of this proxy, since its score is based on z-scores as opposed

[6] The same conclusions hold if (i) we divide the sample in halves instead of terciles, in order to retain more observations, or if (ii) instead of splitting the sample in terciles we interact the actual value of the proxy used for the quality of corporate governance with the change in cash.

to absolute scores and therefore distinguishes the best and worst governed firms instead of well and poorly governed firms. Together with the apparent bias of the availability of score data towards larger companies and the limited available data (available for just 396 companies out of the initial sample of 3005), it could be possible that most of the companies ranked by the score are already well governed in absolute terms, which could distort our results.

Finally, a negative correlation between the quality of corporate governance and the degree of financial constraint of a given firm could influence these results (Drobetz et al., 2010), with better governed firms having easier access to external financing if more effective corporate governance results in decreased conflicts of interest and information asymmetry between management and the providers of external finance. Under this hypothesis, a negative relationship between the quality of governance and the marginal value of cash would be expected, since the well-governed firms are also less financially constrained. We find such relationship in our data when comparing the corporate governance score and our two proxies for financial constraints, size and age. However, the magnitude of the correlation coefficients is low (0.17 and 0.06 for size and age, respectively), which is unsupportive of a strong relationship between those variables.

The last analysis in this section pertains to the impact of acquisition activity on the marginal value of cash (H6). Our estimation points to a positive, statistically significant relationship between the degree of acquisition activity and the marginal value of cash.[7] This result suggests that instead of discounting the marginal value of cash for firms in the highest tercile of acquisition activity, the market places a premium on additional cash held by these companies, which contradicts the hypothesis that cash used for acquisitions is poorly allocated. We offer two potential explanations for this result. Firstly, the fact that we use the variation in total cash instead of excess cash may influence the results of the estimation. In fact, most arguments that Jensen (1986) and other authors (Dittmar & Mahrt-Smith, 2007; Harford, 1999; Harford et al., 2008; Lee & Powell, 2011) put forward for the employment of cash in value-destroying activities pertains to excess cash, not total cash. Therefore, it may be the case that the acquisitions performed by firms with little to no excess cash are more likely to

[7] Conclusions remain the same in terms of coefficient sign, magnitude and statistical significance if (i) the market value of equity is instead of the book value of assets, (ii) yearly values of the acquisition ratio are used instead of ratio averages across the 12 years and (iii) a dummy signalling the existence or inexistence of acquisition activity, instead of the acquisition ratio, is used.

be value adding as opposed to value destroying. A more accurate judgment on this hypothesis would require excess cash to be defined and computed for every firm in our sample.

The second explanation relates to the effects of excess cash holdings themselves: whereas some authors – including the aforementioned - support the idea that excess cash tends to be spent unwisely by managers, thereby decreasing firm value, others conclude that excess cash holdings are valuable as buffers for periods of harder to access external financing (Duchin et al., 2010; Kim et al., 1998; Opler et al., 1999), arguing the benefits of excess cash are seldom weighted against the agency costs of it. Furthermore, Mikkelson and Partch (2003) and Opler et al. (1999) find that while firms holding excess cash do perform more acquisitions, they also pay out more to shareholders and tend to exhibit better investment opportunities, more difficulty in accessing external financing and better operating performance overall. As such, it is possible that the same firms which tend to perform the most acquisitions are also those with characteristics most likely associated with higher marginal values of cash, hence the positive coefficient estimate.

The aforementioned findings for the quality of corporate governance and acquisition activity contradict the agency motive for holding cash and the free cash flow theory (Jensen, 1986), according to which we should expect a positive between the former and the marginal value of cash and negative relationship for the latter.

We do not perform estimations regarding hypotheses H6.1 and H6.2 given our results for the quality of corporate governance are the opposite of what was expected.

5.3. Degree of Financial Constraint

The assessment of the impact of financial constraints on the marginal value of cash is done both between firms and between Eurozone countries. Table 5 presents the results for the relation between firm size and age, our two proxies for the degree of financial constraint faced by any given firm, and the marginal value of cash.

Table 5 - Estimation output of the base model with interactions for firm size and age

Independent Variables	Size	Age
Intercept	0,037 (0.027)	0.050* (0.027)

ΔC_t	0.644*** (0.062)	0.775*** (0.060)
ΔE_t	0.116*** (0.017)	0.117*** (0.018)
ΔNA_t	0.068*** (0.010)	0.094*** (0.011)
ΔRD_t	0.420 (0.412)	0.459 (0.463)
ΔI_t	-0.334** (0.154)	-0.048 (0.189)
ΔD_t	0.573** (0.213)	0.672** (0.295)
C_{t-1}	0.242*** (0.040)	0.276*** (0.043)
L_t	-0.393*** (0.049)	-0.370*** (0.047)
NF_t	-0.069*** (0.025)	-0.088*** (0.024)
$C_{t-1}*\Delta C_t$	-0.221*** (0.055)	-0.111** (0.052)
$L_t*\Delta C_t$	-0.310*** (0.092)	-0.364*** (0.094)
$SIZE_t$	0.103*** (0.029)	-
$SIZE_t*\Delta C_t$	0.032 (0.054)	-
AGE_t	-	0.048*** (0.016)
$AGE_t*\Delta C_t$	-	-0.223*** (0.055)
Observations	12308	10947
Adjusted R^2	0.113	0.119
F-Statistic	121.47	114.74

This table presents the estimation output of the models interacting the two proxies for financial constraints, firm size and age, with the change in cash. The independent variables are regressed against the excess return of any given stock over the benchmark throughout a given fiscal year. C_t is cash and marketable securities; Et is net income; NA_t is total assets minus cash and marketable securities; RDt is R&D expenditures, set to 0 if missing; It is interest expenses; D_t is dividend payments; Lt is market leverage, measured as book debt divided by book debt plus market equity; NFt is net financing, defined as net financing cash flow excluding dividend payments. $SIZE_t$ and AGE_t are dummy variables dividing the sample into the top and bottom tercile of firm size and age, respectively. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All variables barring Lt, the dependent variable and the dummy variables are deflated by the lagged market value of equity. All variables are winsorized at the 1st and 99th percentiles. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

The correlation between both proxies is just 0.08, which suggests that the two proxies are more likely to be complementary than substitutes as far as reflecting the degree of financial constraint faced by the firms in our sample goes.

The estimation output from table 5 shows that the interaction between firm size and the change in cash is not statistically significant at any of the more commonly used significance levels[8], whereas that between firm age and the change in cash is significant at the 0.01 level.

Consequently, the statistical evidence provides some support for hypothesis H7, according to which firms facing deeper constraints should retain more valuable cash. The coefficient on the interaction between firm size and the change in cash is positive, albeit marginally, which suggests additional euros of cash are worth virtually the same regardless the size of the firm. This result is inconsistent with the hypothesis that larger firms tend to have easier access to external financing, backed by most literature using firm size individually as a proxy for financial constraints (Almeida et al., 2004; Denis & Sibilkov, 2010; Faulkender & Wang, 2006), but the lack of statistical significance impedes more robust conclusions. Nonetheless, it is relevant to note Drobetz et al. (2010) also do not find statistically significant results for the impact of firm size on the value of cash when using an estimation approach – the Fama and Macbeth (1973) procedure - which, like us, accounts for a time effect in the data.

In contrast, the coefficient on the interaction between firm age and the change in cash is both economically and statistically significant and consistent with the underlying hypothesis. According to our estimation, the youngest firms in our sample have an additional €0.233 placed on additional retained cash when compared to the oldest firms, a 57% difference (€0.639 versus €0.406). This evidence is supportive of the hypothesis that more constrained firms draw more value from retaining cash than firms with easier and cheaper access to external financing, which is consistent with the conclusions of Bates et al. (2017), Chan et al. (2013), Denis and Sibilkov (2010), Dittmar and Mahrt-Smith (2007) and Faulkender and

[8] The results remain unchanged if we use (i) the absolute values of the book value of assets as opposed to terciles, (ii) winsorize the book value of assets at the 95th percentile, (iii)) use the market value of assets – market value of equity plus book value of debt – as a proxy for size instead of book value or (iv) add a quadratic term to account for a potential quadratic relation between firm size and the degree of financial constraint, following Hadlock and Pierce (2010).

Wang (2006), as well as with the precautionary motive and, by extension, the trade-off and pecking order theories for holding cash.

It is pertinent to stress that these conclusions are dependent on how well our proxies for financial constraints, size and age, actually reflect the difficulties faced by firms when accessing external finance. Hadlock and Pierce (2010) argue that these two proxies – particularly firm size - not only reliably reflect such difficulties, but are also more effective than other more common proxies (see section 4.2). However, Farre-Mensa and Ljungqvist (2016) conclude that most firms classified as constrained by these and other proxies do not behave as financially constrained firms and are not limited in their ability to invest and grow; quite the opposite. Therefore, they argue that these measures are more likely to identify young and fast-growing firms more so than those deprived of financing.

5.3.1. Effect of the Financial Crisis

In order to assess the impact of the financial crisis on the degree of financial constraint faced by Eurozone firms from different countries, we resort to the four different interactions with the change in cash described in section 4.2.

Table 6 - Estimation output of the base model with interactions with proxies for the financial crisis

Independent Variables	Crisis Countries	Crisis Years	Crisis Countries and Years	Government Bond Yields
Intercept	0.083** (0.028)	0.097** (0.033)	0.084*** (0.026)	0.08*** (0.026)
ΔC_t	0.649*** (0.047)	0.631*** (0.053)	0.643*** (0.047)	0.643*** (0.046)
ΔE_t	0.118*** (0.014)	0.117*** (0.015)	0.118*** (0.015)	0.118*** (0.015)
ΔNA_t	0.075*** (0.009)	0.007*** (0.009)	0.007*** (0.009)	0.074*** (0.009)
ΔRD_t	0.273 (0.381)	0.262 (0.385)	0.274 (0.382)	0.282 (0.381)
ΔI_t	-0.154 (0.145)	-0.161 (0.145)	-0.151 (0.145)	-0.120 (0.147)
ΔD_t	0.858** (0.272)	0.822** (0.270)	0.856*** (0.272)	0.835** (0.270)
C_{t-1}	0.249*** (0.040)	0.248*** (0.040)	0.248*** (0.040)	0.244*** (0.046)
L_t	-0.376*** (0.048)	-0.363*** (0.046)	-0.371*** (0.046)	-0.363*** (0.048)
NF_t	-0.073*** (0.021)	-0.074* (0.021)	-0.007*** (0.022)	-0.071*** (0.021)

$C_{t-1}*\Delta C_t$	-0.132** (0.043)	-0.131** (0.040)	-0.132*** (0.040)	-0.125** (0.041)
$L_t*\Delta C_t$	-0.334*** (0.076)	-0.358*** (0.072)	-0.324** (0.076)	-0.363*** (0.072)
CC_t	0.012 (0.034)	-	-	-
$CC_t*\Delta C_t$	-0.058 (0.049)	-	-	-
CY_t	-	-0.032 (0.040)	-	-
$CY_t*\Delta C_t$	-	0.026 (0.051)	-	-
CCY_t	-	-	-0.001 (0.0.043)	-
$CCY_t *\Delta C_t$	-	-	-0.096* (0.056)	-
$YIELD_t$	-	-	-	-0.058 (0.004)
$YIELD_t*\Delta C_t$	-	-	-	0.055 (0.057)
Observations	18649	18649	18649	18649
Adjusted R^2	0.114	0.115	0.114	0.116
F-Statistic	184.98	186.95	184.94	189.14

This table presents the estimation output of the models interacting the European countries most affected by the financial crisis, the period of the crisis, an aggregate measure combining both countries and period and the change in each country's government bond yield with the change in cash. The independent variables are regressed against the excess return of any given stock over the benchmark throughout a given fiscal year. C_t is cash and marketable securities; Et is net income; NA_t is total assets minus cash and marketable securities; RDt is R&D expenditures, set to 0 if missing; It is interest expenses; D_t is dividend payments; Lt is market leverage, measured as book debt divided by book debt plus market equity; NFt is net financing, defined as net financing cash flow excluding dividend payments. CC_t, CY_t and CCY_t are dummy variables which classify the countries affected by the crisis and its years as detailed in section 4.2. $YIELD_t$ is the yearly percentage change in the yield of each country's 10-year government bonds. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All variables barring Lt, the dependent variable and the interaction variables are deflated by the lagged market value of equity. All continuous variables except $YIELD_t$ are winsorized at the 1st and 99th percentiles. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

Only one of the interactions presented in table 6, that between the countries which underwent EU intervention during a specific time period and the change in cash ($CCY_t *\Delta C_t$), is significant at a level below 0.10[9]. Furthermore, only two out of the four variables'

[9] When no winsorizing is done, CCYt *ΔCt becomes statistically significant at the 0.01 level and CCt*ΔCt at the 0.05 level, which suggests that the outliers may carry valuable information, presumably because their extreme values reflect high sensitivity to effects of the crisis. Nonetheless, the signs and magnitudes on the coefficients remain the same, leaving the conclusions unchanged.

coefficients - $CY_t*\Delta C_t$ and YIELDt*ΔCt - carry a sign consistent with our hypotheses for the impact of the financial crisis on the market value of cash (H8 and H9). The estimate of the first implies a small premium being placed on such value during the most critical period of the European sovereign debt crisis (2008-2013), as the result of increased financial constraints faced by Eurozone firms throughout the period ensuing from harder or more expensive access to external finance. The coefficient estimate on the interaction between the yield of each country's 10-year government bonds, reflective of the financial markets' perception of country risk, and the change in cash is positive, suggesting that an increase in yield – presumably from an increase in perceived default risk – results in a slight increase of the marginal value of cash. Assuming increased risk premiums on government debt pass through to firms under higher costs of capital and, therefore, more expensive external financing, we should expect this relationship to be positive, consistently with our findings.

The interactions of the change in cash with both the most affected Eurozone countries (Greece, Portugal, Ireland and Spain) and our hybrid classification considering the countries and the timing of the financial assistance packages simultaneously returns negative signs on the coefficients, hinting at the possibility of an additional euro of cash being worth less for those countries relative to the others– opposite our hypothesis.

Overall, the statistical evidence does not allow for robust conclusions with regards to these hypotheses, given our estimates are not only contradictory but also carry little to no statistical and economic significance. Consequently, these findings disagree with those of Campello et al. (2010) and Duchin et al. (2010), who report that constrained firms without sufficient internal financing capabilities performed the worst during the crisis – suggestive of higher values placed on additional cash - and that the increased economic uncertainty of the 2000s lead to an increase in the marginal value of cash (Bates et al., 2017).

However, Chang et al. (2017) do find that the effect of the crisis on the marginal value of cash for constrained firms is lower than for unconstrained firms, arguing that constrained firms tend to be more dependent on internal financing – thus saving more cash (Almeida et al., 2004) and incurring less debt - and are therefore less affected by shocks to the supply of external finance. Under this hypothesis, additional cash is expected to be more valuable during times of crisis for unconstrained firms, opposite to our initial prediction. This would be consistent with the results obtained for our only statistically significant coefficient (of variable CCYt *ΔCt, at the 0.10 level), which suggests that the firms headquartered in the

countries which received financial assistance from the EU, presumably more constrained than their other Eurozone peers as their countries lost access to financial markets, actually commanded a lower value for additional euros of cash relative to the other firms during the crisis period, since the dependence on cash increased more for the latter than for the former.

The finding that the marginal value of cash is lower for the countries where financial constraints are expected to be higher may be reflective of other differences between the countries which are not accounted for in our specification and could be biasing the value of cash in those countries. For instance, Drobetz et al. (2010) draw conclusions similar to ours when comparing the impact of financial constraints between countries, arguing that a negative correlation between the degree of financial constraint and the quality of corporate governance[10] could potentially explain the unexpected result. However, we tested the difference in corporate governance scores between firms of the countries which underwent EU intervention and the other Eurozone countries and found the average values of the score to be higher for the latter (44.7 and 50.5, respectively), but negligibly. Therefore, and given our proxy for the quality of corporate governance, this explanation does not seem suited for our sample, even though that does not exclude the possibility of other, not accounted for differences between countries still biasing our results.

Lastly, we offer another potential explanation for why the impact of the financial crisis on the marginal value of cash may be negative as opposed to positive, as initially hypothesized: given the severe economic downturn which characterized the financial crisis of 2008 it is expected that the perceived number and quality of available investment opportunities declined precipitously for most, if not all firms during such a period. Therefore, and whilst in relative terms some firms likely still retain better investment opportunities than others, it may be the case that the good overall expected investment opportunities prior to the crisis gave way to generally poor future investment prospects after the crisis. In this setting, cash which could have previously added value by being retained, since it would decrease the probability of value adding investment opportunities not being seized under situations where other financing sources are hard to access, could now be worth considerably less as one of the main drivers of its value, the availability of quality investment opportunities, ceases to

[10] Drobetz et al. (2010) use multiple proxies for differences in governance practises between countries, such as the rule of law and corruption indexes, as opposed to proxies for differences between firms. This approach is also followed by Ferreira and Vilela (2004).

exist as the result of the financial crisis. This could also explain the lower marginal value of cash for firms in the intervened countries, given their economies and, by extension, the expectations of valuable investment opportunities, suffered the most within the Eurozone.

5.4. Robustness Tests

The empirical analysis conducted in the previous sections builds on the empirical model proposed by Faulkender and Wang (2006), described in more detail in section 4.1, estimated using pooled OLS with standard errors clustered by time for purposes of comparison with previous literature and flexibility when estimating.

In this section, we perform robustness tests by 1) using a firm fixed effects model as opposed to pooled OLS, since some authors estimate the former as the main or auxiliary model (Chan et al., 2013; Drobetz et al., 2010) to account for unobserved firm-specific factors which are constant over time, and 2) employing a different empirical model commonly used in the literature (Bates et al., 2017; Dittmar & Mahrt-Smith, 2007; Drobetz et al., 2010; Pinkowitz et al., 2006; Pinkowitz & Williamson, 2005, 2007), adapted from the firm valuation model of Fama and French (1998) also briefly described in section 4.1. These two tests are intended to assess how robust our conclusions are with respect to different model specifications and follow those performed by Chan et al. (2013). For brevity and ease of interpretation, we choose to present the interaction between our test variables and the change in cash for each model only, omitting the other independent variables.

Table 7 summarises the results for the model with firm fixed effects by presenting the coefficient estimates for the interaction between the variables under hypothesis testing and the change in cash (ΔCt), comparing it with the results obtained for the pooled OLS model.

Table 7 - Summary of the firm fixed effects estimation output

	Interaction with ΔCt		Firm Fixed Effects Estimation		
Independent Variables	Pooled OLS	Firm Fixed Effects	Observations	Adjusted R^2	F-Statistic
C_{t-1}	-0.132*** (0.041)	-0.156*** (0.042)	18649	0.179	2.530
L_t	-0.357*** (0.041)	-0.337*** (0.077)	18649	0.179	2.530
C_{t-1}^2	0.079 (0.069)	0.110 (0.073)	18649	0.179	2.531

IO_t	0.286*** (0.064)	0.221*** (0.061)	12304	0.211	2.332
UCF_t	0.159*** (0.058)	n.a.	n.a.	n.a.	n.a.
CG_t	-0.404*** (0.147)	-0.121 (0.106)	2296	0.203	2.500
ACQ_t	0.139*** (0.047)	0.097** (0.041)	15531	0.190	2.38
$SIZE_t$	0.032 (0.054)	0.068 (0.052)	12308	0.187	2.319
AGE_t	-0.223*** (0.055)	n.a.	n.a.	n.a.	n.a.
CC_t	-0.058 (0.049)	n.a.	n.a.	n.a.	n.a.
CY_t	0.026 (0.051)	0.015 (0.051)	18649	0.179	2.528
CCY_t	-0.096* (0.056)	-0.092* (0.057)	18649	0.179	2.530
$YIELD_t$	0.055 (0.057)	0.050 (0.058)	18649	0.182	2.556

This table compares the estimation output of the interaction of our main proxy variables with the change in cash when estimated through pooled OLS and firm fixed effects. *Ct* is cash and marketable securities and *Lt* is market leverage, measured as book debt divided by book debt plus market equity. *IOt, UCFt, CGt, ACQt, SIZEt* and AGE_t are dummy variables dividing the sample into the top and bottom terciles of investment opportunities, uncertainty of cash flows, quality of corporate governance, degree of acquisition activity, firm size and age, respectively. CC_t, CY_t and CCY_t are dummy variables which classify the countries affected by the crisis and its years as detailed in section 4.2. $YIELD_t$ is the yearly change in the yield of each country's 10-year government bonds. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All continuous variables except $YIELD_t$ are winsorized at the 1st and 99th percentiles. "n.a." denotes firm fixed effects estimations which cannot be performed as the result of the presence of time-invariant variables. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

The similarity between the pooled OLS and firm fixed effects estimation noted for the base model (section 5.1) remains once we estimate both models for each hypothesis. The signs, magnitudes and statistical significance of the coefficient estimates are the virtually the same for the interactions between the change in cash and the lagged level of cash (C_{t-1}), leverage (Lt), investment opportunities (IO_t), acquisition activity (ACQ_t), firm size ($SIZE_t$), the years of the European sovereign debt crisis (CY_t), the years and countries associated with the EU intervention (CCY_t) and the change in government bond yields ($YIELD_t$). Part of the difference in magnitude and statistical significance for the quality of governance (CG_t) results from the use of annual values for the corporate governance index as opposed to average values across the 12 years, used in the pooled OLS model, since the latter would have been collinear. Lastly, some estimations – denoted with "n.a." – could not be performed using

firm fixed effects due to the time-invariant nature of the variables under testing. Overall, we argue our conclusions are robust to a firm fixed effects specification, since our results remain qualitatively the same when compared to the pooled OLS models.

The alternative empirical model adapted from Fama and French (1998) is that of equation 5.1. This model differs from that of Faulkender and Wang (2006) mostly by scaling variables through the book value of assets instead of the market value of equity, as well as using the market value of assets as the dependent variable as opposed to the market value of equity. In addition, this model includes current values as well as past and future change values for profitability, investment, dividend and interest payments. The future change values are meant to capture market expectations – under the assumption that the market can reasonably predict their evolution in the near future, for up to two years - with regards to these variables, since only expected changes can influence the market value of the firm at any given time. Following Pinkowitz and Williamson (2005) and Pinkowitz and Williamson (2007), we use one-year instead of two-year changes, to preserve more observations.

$$\begin{aligned}\frac{M_{i,t}-A_{i,t}}{A_{i,t}} = {} & \alpha_0 + \beta_1\frac{E_{i,t}}{A_{i,t}} + \beta_2\frac{\Delta E_{i,t}}{A_{i,t}} + \beta_3\frac{\Delta E_{i,t+1}}{A_{i,t}} + \beta_4\frac{\Delta NA_{i,t}}{A_{i,t}} + \beta_5\frac{\Delta NA_{i,t+1}}{A_{i,t}} \\ & + \beta_6\frac{RD_{i,t}}{A_{i,t}} + \beta_7\frac{\Delta RD_{i,t}}{A_{i,t}} + \beta_8\frac{\Delta RD_{i,t+1}}{A_{i,t}} + \beta_9\frac{I_{i,t}}{A_{i,t}} + \beta_{10}\frac{\Delta I_{i,t}}{A_{i,t}} \\ & + \beta_{11}\frac{\Delta I_{i,t+1}}{A_{i,t}} + \beta_{12}\frac{D_{i,t}}{A_{i,t}} + \beta_{13}\frac{\Delta D_{i,t}}{A_{i,t}} + \beta_{14}\frac{\Delta D_{i,t+1}}{A_{i,t}} \\ & + \beta_{15}\frac{\Delta M_{i,t+1}}{A_{i,t}} + \beta_{16}\frac{\Delta C_{i,t}}{A_{i,t}} + \beta_{17}\frac{\Delta C_{i,t+1}}{A_{i,t}} + \varepsilon_{i,t}\end{aligned} \qquad 5.1$$

where *i* denotes the individual companies, *t* denotes the fiscal year and $\varepsilon_{i,t}$ denotes the residual term.

The coefficient of interest in this model is coefficient β_{16}, the 1-year change in cash, whose value can be interpreted as the market's valuation of an additional euro of cash.

Table 8 - Summary of the alternative empirical model estimation output

	Interaction with ΔCt		Alternative Model Estimation		
Independent Variables	Base Model	Alternative Model	Observations	Adjusted R^2	F-Statistic
C_{t-1}	-0.132*** (0.041)	-3.739*** (0.866)	16374	0.335	434.25
L_t	-0.357*** (0.041)	-1.783*** (0.077)	16373	0.396	566.04

C_{t-1}^2	0.079 (0.069)	-2.291 (4.930)	16374	0.334	412.55
IO_t	0.286*** (0.064)	1.344*** (0322)	10806	0.464	492.88
UCF_t	0.159*** (0.058)	0.211 (0.337)	10616	0.312	254.59
CG_t	-0.404*** (0.147)	-0.159 (0.648)	2281	0.529	135.84
ACQ_t	0.139*** (0.047)	0.116 (0.358)	10193	0.297	227.67
$SIZE_t$	0.032 (0.054)	-0.548 (0.327)	10808	0.307	252.66
AGE_t	-0.223*** (0.055)	-0.915*** (0.332)	9521	0.303	218.53
CC_t	-0.058 (0.049)	-0.622* (0.332)	16374	0.310	388.16
CY_t	0.026 (0.051)	-0.657** (0.331)	16374	0.319	404.16
CCY_t	-0.096* (0.056)	-1.163** (0.502)	16374	0.309	387.02
$YIELD_t$	0.055 (0.057)	-0.230 (0.540)	16374	0.309	386.70

This table compares the estimation output of the interaction of our main proxy variables with the change in cash when estimated through our pooled OLS base and alternative empirical model. *Ct* is cash and marketable securities and *Lt* is market leverage, measured as book debt divided by book debt plus market equity. *IOt, UCFt, CGt, ACQt, SIZEt* and AGE_t are dummy variables dividing the sample into the top and bottom terciles of investment opportunities, uncertainty of cash flows, quality of corporate governance, degree of acquisition activity, firm size and age, respectively. CC_t, CY_t and CCY_t are dummy variables which classify the countries affected by the crisis and its years as detailed in section 4.2. $YIELD_t$ is the yearly change in the yield of each country's 10-year government bonds. Δ is notation for the change in value between fiscal year *t-1* and fiscal year *t*. All continuous variables except $YIELD_t$ are winsorized at the 1st and 99th percentiles. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

Table 8 compares the results of the base and alternative models' estimation. The conclusions drawn from interpreting the estimations of the alternative model are very similar to those drawn from the base model estimation. Out of the 13 different interactions presented above, 8 carry the same signal on the coefficient estimate for both models, namely the interaction between the change in cash and the lagged level of cash (C_{t-1}), leverage (Lt), investment opportunities (IO_t), uncertainty of cash flows, quality of corporate governance (CG_t), acquisition activity (ACQ_t), firm age (AGE_t), the countries most affected by the European sovereign debt crisis (CC_t) and the years and countries associated with the EU intervention (CCY_t). The level of statistical significance is the same for the lagged value of cash, leverage, investment opportunities and age (0.01 level), whereas that of the uncertainty of cash flows

drops from 0.01 to above 0.10. In contrast, CC_t and CCY_t are significant at lower levels whereas the quality of corporate governance and the degree of acquisition activity are not statistically significant in the alternative model.

The alternative model estimation returns different signals for the interaction between the change in cash and the squared level of cash (C_{t-1}^2), firm size ($SIZE_t$), the period of the crisis (CY_t) and the change in government bond yields ($YIELD_t$).

The negative coefficient estimate for the impact of firm size on the marginal value of cash is supportive of the hypothesis that bigger, less financially constrained firms draw lower value from retaining cash than smaller firms, under the assumption that size is a good proxy for the degree of financial constraint, with bigger firms having easier access to external financing (Hadlock & Pierce, 2010). However, unlike the estimate on firm age, which is statistically significant at the 0.01 level in both models, the coefficient estimate on firm size is not statistically significant at the most common levels, which prevents more definite conclusions regarding the effect of firm size on the marginal value of cash.

The interaction between the three dummies identifying the crisis period and most affected countries (CC_t, CY_t and CCY_t) is negative and statistically significant – at the 0.10 level, for the first, and at the 0.05 level, for the second and third, which offers further statistical support for the conclusion obtained from the base model that the crisis had a negative, as opposed to positive impact on the marginal value of cash (H8) and that such value was lower for the most affected countries, as opposed to higher (H9), for the potential reasons we have outlined in section 5.3.1.

Lastly, it is interesting to note that the estimate of the marginal value of cash for the entire sample (unreported) is considerably larger in the alternative model than in the base model. Our above unity estimate for the first of €1.366 contrasts with the below unity estimate of €0.503 obtained for our base empirical model. This discrepancy is also found in the research by Chan et al. (2013), who report an average marginal value of cash of AU$0.867 for the base model following Faulkender and Wang (2006) versus AU$1.520 for the alternative model based on the model of Fama and French (1998).

Summarily, the firm fixed effects and alternative model estimations presented in this section as robustness tests both add strength to the results and conclusions initially reached by estimating the base model of Faulkender and Wang (2006) through pooled OLS.

6. Conclusions

In this study, we seek to ascertain how the marginal value of cash of Eurozone firms is influenced by the level of cash, leverage, available investment opportunities, uncertainty of cash flows, quality of corporate governance, acquisition activity, degree of financial constraint and the financial crisis of 2008.

Our results for the impact of the level of cash (negative), leverage (negative), the available investment opportunities (positive), the uncertainty of cash flows (positive) and firm age (negative) are statistically significant and in agreement with our initial hypotheses, as well as most of the available literature. Conversely, the effects of the quality of corporate governance (negative), acquisition activity (positive) and the financial crisis (negative) are opposite our initial predictions and vary in statistical significance.

We argue that an incomplete proxy for the quality of corporate governance and the possibility that the firms with the largest acquisition activity also bear characteristics that could be associated with a larger marginal value of cash – i.e better investment opportunities and valuable excess cash for periods of increased financial constraints – may be potential explanations for these results. Regarding the negative impact of the financial crisis on the marginal value of cash, we offer two main potential explanations for it: (i) firms located in the countries that characterized the European sovereign debt crisis, namely Greece, Portugal, Ireland and Spain, were already more financially constrained prior to the crisis and thus less reliant on external financing, therefore being less affected by the crisis and commanding a lower marginal value of cash compared to the other firms which saw greater variations in their access to financing, and (ii) the plunge in economic activity resulting from the crisis severely hindered most expectations of profitable investment opportunities, particularly in those countries, leading one of the main drivers of the value of cash to plummet and thereby dragging down the marginal value of cash during the period of the crisis.

This evidence is most supportive of the precautionary motive for holding cash and offers mixed support for the agency motive. None of the three main theories of cash holdings is fully consistent with our findings, but the existence of both positive and negative drivers of the value of cash corroborates the existence of benefits and costs to holding cash and, by extension, the trade-off theory of cash holdings, even though we find no evidence suggesting that firms may have an optimal level of cash.

Our conclusions are generally robust to the estimation of both a firm fixed effects model and an alternative model proposed in the literature.

6.1. Practical Recommendations

These results carry relevant implications for both firm managers, focused on maximizing firm value, and policymakers, seeking to promote and facilitate economic growth.

(i) Firm Managers

Managers can improve their cash management and payout policies by understanding how their firms' characteristics relate to the marginal value of cash. For instance, managers of mature firms, which are likely to have high free cash flow generation and rising cash balances, be less financially constrained – being older, more established firms - and have less profitable investment opportunities available - as their investment opportunity set has been more exhausted - should ponder increasing payouts to shareholders. Considering additional cash tends to be worth less for firms with these characteristics, doing so could increase firm value by distributing cash potentially valued below its nominal value. In contrast, managers of younger growth firms, whose characteristics tend to be opposite those described for mature firms, can act optimally by opting to retain cash instead of distributing it.

Another example pertains to managers of firms with more volatile cash flows, such as those with volatile output prices – natural resources companies or those selling more discretionary products – or high operating leverage resulting from a fixed cost heavy cost structure. These managers could potentially increase firm value by retaining more cash, which allows the firm to better withstand periods of lower profitability.

(ii) Policymakers

Our conclusions can also be valuable for policymakers looking to improve the allocation of capital within their economies, thereby helping channel it towards the most productive uses.

One policy which can be pursued with that goal in mind is the minimization of the taxation faced by younger, growing companies. Since these companies tend to have a harder time accessing external financing and often have the most valuable investment opportunities

available, policies such as tax loss carryforwards and tax breaks for firms with low but rising profits can be value promoting by allowing more valuable cash to be retained and invested.

In contrast, policies aimed at incentivizing cash retention to improve firm solvency, such as tax benefits for retained earnings, can arguably promote capital misallocation within the economy. Older, undercapitalized firms often reach that status after years of losses draining their equity base, which can reflect the lack of good investment opportunities for these firms. This, together with the high leverage, increases the probability of additional cash being worth less for these firms. Therefore, those policies can increase the retention of cash which would be better distributed and put to more productive use outside the firm by its shareholders.

6.2. Limitations of the Study and Suggestions for Future Research

We consider some of the proxies used to be the main limitations of the present study, as discussed in sections 5.3 and 5.4. More specifically, the choice of appropriate and reliable proxies for the quality of corporate governance and the degree of financial constraint is of the essence to allow for significant and accurate conclusions. The high number of available disciplinary mechanisms and the relations of complementarity and substitution between them result in a plethora of effective corporate governance structures, making it hard for individual and even composite – such as our own – proxies to accurately reflect the quality of the governance structure chosen by a given firm. Regarding financial constraints, and even though Hadlock and Pierce (2010) conclude that firm size and age constitute good proxies for how hard it is for firms to access external financing, there is still no consensus in the literature (Farre-Mensa & Ljungqvist, 2016). Therefore, we suggest that future research on the marginal value of cash places particular focus on the impact of these two variables, potentially testing multiple proxies for each at the same time in order to arrive at more robust conclusions.

Finally, we use changes in total cash as our main independent variable, following most of the literature. Nonetheless, performing a similar study using excess cash levels as opposed to total cash levels and/or levels of cash as opposed to changes could add robustness to the results obtained with our methodology. Additional empirical research on the existence of an optimal level of cash may also be valuable, given current evidence is not plentiful and provides only mixed support for such hypothesis.

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8. Appendices

8.1. Appendix A – Multicollinearity Testing

Base Model – Correlation Matrix

Table 9 - Correlation matrix of the base model's independent variables

	ΔC_t	C_{t-1}	ΔE_t	ΔNA_t	ΔRD_t	ΔI_t	ΔD_t	L_t	NF_t
ΔC_t	1.000	-0.185	0.087	-0.017	0.013	0.048	-0.002	0.000	0.193
C_{t-1}	-0.185	1.000	0.079	-0.093	-0.022	-0.129	-0.031	0.2561	-0.020
ΔE_t	0.087	0.079	1.000	-0.012	-0.045	-0.200	0.010	0.019	-0.075
ΔNA_t	-0.017	-0.093	-0.012	1.000	0.070	0.324	0.089	-0.179	0.356
ΔRD_t	0.013	-0.022	-0.045	0.070	1.000	0.017	0.037	-0.046	0.013
ΔI_t	0.048	-0.129	-0.200	0.324	0.017	1.000	0.043	-0.061	0.228
ΔD_t	-0.002	-0.031	0.010	0.089	0.037	0.043	1.000	-0.078	0.034
L_t	0.000	0.256	0.019	-0.179	-0.046	-0.061	-0.078	1.000	0.059
NF_t	0.193	-0.020	-0.075	0.355	0.013	0.228	0.033	0.059	1.000

Base Model – Variance Inflation Factors (VIFs)

Table 10 - VIF testing for the base model

Independent Variables	Uncentered VIF
Intercept	2.786
ΔC_t	3.902
ΔE_t	1.077
ΔNA_t	1.323
ΔRD_t	1.011
ΔI_t	1.201
ΔD_t	1.014
C_{t-1}	1.647
L_t	2.888
NF_t	1.262
$C_{t-1}*\Delta C_t$	2.589
$L_t*\Delta C_t$	3.769

Alternative Model – Correlation Matrix

Table 11 - Correlation matrix of the alternative model's independent variables

	E_t	ΔE_t	ΔE_{t+1}	ΔNA_t	ΔNA_{t+1}	RD_t	ΔRD_t	ΔRD_{t+1}	I_t	ΔI_t	ΔI_{t+1}	D_t	ΔD_t	ΔD_{t+1}	ΔM_{t+1}	ΔC_t	ΔC_{t+1}
E_t	1.000	0.386	-0.412	0.377	0.153	-0.191	0.058	0.087	-0.320	0.010	0.040	0.350	0.111	0.097	0.027	0.114	0.000
ΔE_t	0.386	1.000	-0.308	0.114	0.053	0.001	-0.066	0.028	-0.015	-0.107	-0.020	-0.036	0.028	0.128	0.021	0.083	0.000
ΔE_{t+1}	-0.412	-0.308	1.000	-0.215	0.105	0.034	-0.068	-0.06	0.098	-0.026	-0.085	-0.033	-0.049	0.024	0.105	-0.063	0.107
ΔNA_t	0.377	0.113	-0.215	1.000	0.171	-0.047	0.105	0.088	-0.239	0.264	0.261	0.005	0.042	0.081	0.029	-0.056	0.066
ΔNA_{t+1}	0.153	0.053	0.105	0.171	1.000	0.012	0.045	0.090	-0.126	0.023	0.331	0.038	0.019	0.048	0.393	0.132	0.006
RD_t	-0.191	0.001	0.034	-0.047	0.012	1.000	0.257	0.005	-0.099	-0.009	0.000	0.027	-0.002	-0.004	0.055	-0.013	0.031
ΔRD_t	0.059	-0.066	-0.067	0.105	0.045	0.255	1.000	0.078	-0.058	0.016	0.000	0.036	0.019	-0.004	0.010	0.041	0.002
ΔRD_{t+1}	0.087	0.028	-0.065	0.088	0.090	0.004	0.078	1.000	-0.049	-0.007	0.014	0.033	0.025	0.026	0.049	0.086	0.042
I_t	-0.320	-0.015	0.098	-0.239	-0.126	-0.099	-0.058	-0.049	1.000	0.140	-0.265	-0.206	-0.035	-0.041	-0.076	-0.057	-0.028
ΔI_t	0.010	-0.107	-0.029	0.264	0.023	-0.009	0.016	-0.007	0.140	1.000	0.026	0.020	0.021	-0.031	-0.016	0.047	-0.002
ΔI_{t+1}	0.041	-0.020	-0.085	0.261	0.331	0.000	0.000	0.014	-0.265	0.026	1.000	0.013	0.010	0.019	0.113	0.022	0.078
D_t	0.350	-0.036	-0.032	0.005	0.038	0.027	0.036	0.033	-0.206	0.020	0.013	1.000	0.347	-0.286	0.036	-0.038	0.000
ΔD_t	0.111	0.028	-0.049	0.042	0.019	-0.003	0.019	0.025	-0.035	0.021	0.010	0.347	1.000	-0.222	0.002	-0.016	-0.008
ΔD_{t+1}	0.097	0.128	0.024	0.081	0.0478	-0.004	-0.004	0.026	-0.041	-0.031	0.019	-0.286	-0.222	1.000	0.036	0.105	-0.006
ΔM_{t+1}	0.027	0.021	0.105	0.029	0.393	0.055	0.011	0.049	-0.076	-0.016	0.113	0.036	0.002	0.036	1.000	0.040	0.228
ΔC_t	0.114	0.083	-0.063	-0.056	0.132	-0.013	0.040	0.086	-0.058	0.05	0.022	-0.038	-0.016	0.105	0.040	1.000	-0.172
ΔC_{t+1}	0.000	0.000	0.107	0.066	0.006	0.031	0.002	0.041	-0.028	-0.003	0.078	0.000	-0.008	-0.006	0.228	-0.176	1.000

Alternative Model – Variance Inflation Factors (VIFs)

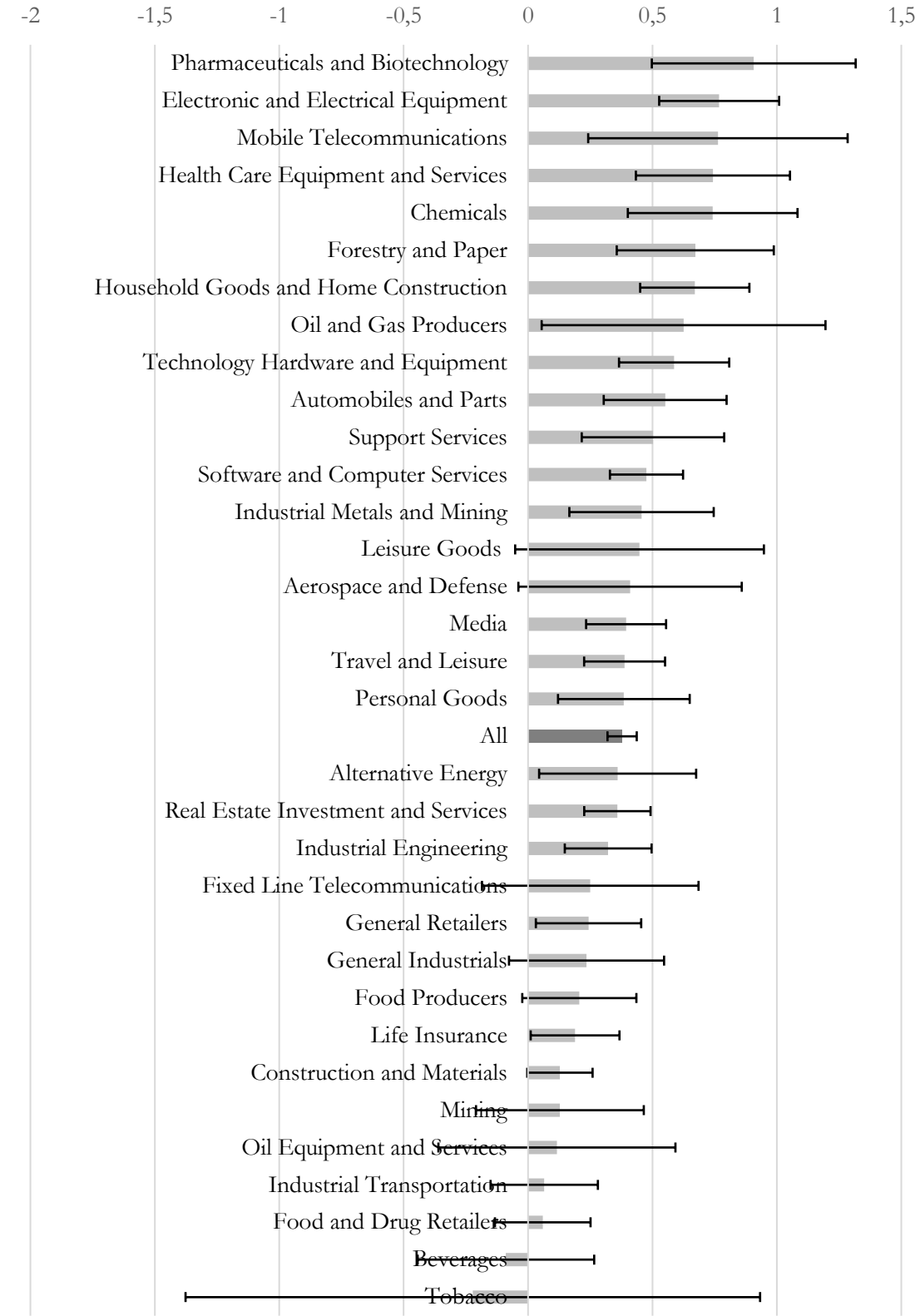
Table 12 - VIF testing for the alternative model

Independent Variables	Uncentered VIF
Intercept	3.702
E_t	2.293
ΔE_t	1.350
ΔE_{t+1}	1.415
ΔNA_t	1.527
ΔNA_{t+1}	1.522
RD_t	1.371
ΔRD_t	1.124
ΔRD_{t+1}	1.038
I_t	2.049

ΔI_t	1.176
ΔI_{t+1}	1.310
D_t	2.049
ΔD_t	1.171
ΔD_{t+1}	1.205
ΔM_{t+1}	1.298
ΔC_t	1.124
ΔC_{t+1}	1.145

8.2. Appendix B – Marginal Value of Cash by Industry

Figure 1 - Marginal value of cash by industry



This figure visually presents the estimated marginal value of cash for a set of 33 industries the firms in our sample belong to. The marginal value of cash was estimated following the model of Faulkender and Wang (2006) but excluding the interaction terms with leverage and lagged cash in order to facilitate the interpretation of the confidence intervals for the estimate. The horizontal bars represent the interval estimate of the marginal value of cash given a 95% confidence interval based on panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence. Table 13 provides complementary information.

Table 13 - Summary statistics on the marginal value of cash by industry

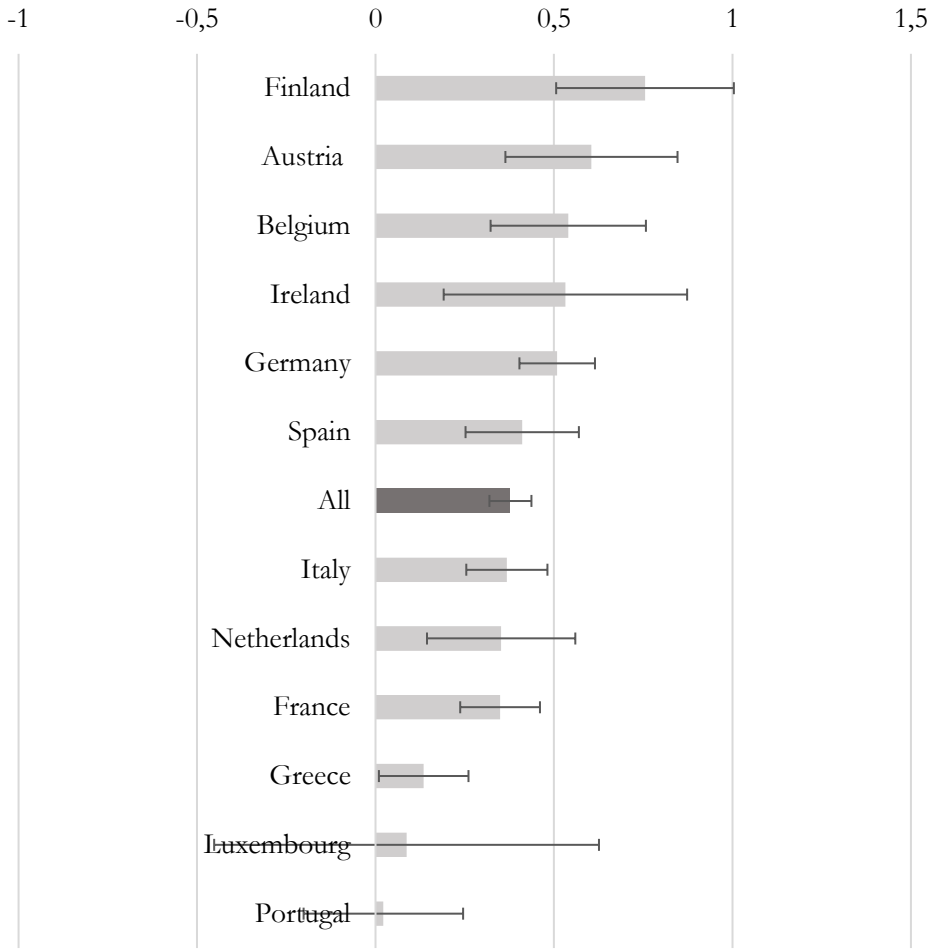
Industry	Marginal Value of Cash	Range (95% confidence interval)	Observations	Firms
Pharmaceuticals and Biotechnology	0.907*** (0.209)	0.497; 1.317	667	109
Electronic and Electrical Equipment	0.768*** (0.123)	0.527; 1.009	764	102
Mobile Telecommunications	0.763*** (0.266)	0.242; 1.284	109	20
Health Care Equipment and Services	0.743*** (0.158)	0.433; 1.053	606	98
Chemicals	0.742*** (0.174)	0.401; 1.083	614	80
Forestry and Paper	0.672*** (0.161)	0.356; 0.988	215	26
Household Goods and Home Construction	0.670*** (0.112)	0.450; 0.890	622	87
Oil and Gas Producers	0.625** (0.291)	0.055; 1.195	214	23
Technology Hardware and Equipment	0.587*** (0.113)	0.366; 0.808	736	101
Automobiles and Parts	0.551*** (0.126)	0.304; 0.798	509	57
Support Services	0,502*** (0.146)	0.216; 0.788	839	129
Software and Computer Services	0.476*** (0.075)	0.329; 0.623	1944	316
Industrial Metals and Mining	0.456*** (0.148)	0.166; 0.746	360	47
Leisure Goods	0.448* (0.255)	-0.052; 0.948	286	44
Aerospace and Defense	0.410* (0.229)	-0.039; 0.859	149	20
Media	0.394*** (0.082)	0.233; 0.555	1203	167
Travel and Leisure	0.388*** (0.083)	0.225; 0.551	831	114
Personal Goods	0.385*** (0.135)	0.120; 0.650	732	112
All	0.378*** (0.030)	0.319; 0.437	18649	2648

Alternative Energy	0.360** (0.161)	0.044; 0.676	209	34
Real Estate Investment and Services	0.359*** (0.068)	0.226; 0.492	1061	167
Industrial Engineering	0.322*** (0.089)	0.148; 0.496	1220	151
Fixed Line Telecommunications	0,250 (0.222)	-0.185; 0.685	174	24
General Retailers	0.243** (0.108)	0.031; 0.455	613	101
General Industrials	0,235 (0.159)	-0.077; 0.547	392	49
Food Producers	0.206* (0.117)	-0.023; 0.435	923	125
Life Insurance	0.189** (0.091)	0.011; 0.367	90	13
Construction and Materials	0.128* (0.067)	-0.003; 0.259	1145	146
Mining	0.128 (0.172)	-0.209; 0.465	161	24
Oil Equipment and Services	0.116 (0.243)	-0.360; 0.592	142	16
Industrial Transportation	0.065 (0.110)	-0.151; 0.281	513	66
Food and Drug Retailers	0.059 (0.098)	-0.133; 0.251	234	29
Beverages	-0.089 (0.181)	-0.444; 0.266	357	48
Tobacco	-0.222 (0.589)	-1.376; 0.932	15	3

This table presents the estimation of the marginal value of cash for each of the 33 industries that comprise our sample, in descending order. The interval estimates for each industry, based on a 95% confidence interval, as well as the number of total observations and firms within each estimation are also displayed. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.

8.3. Appendix C – Marginal Value of Cash by Country

Figure 2 - Marginal value of cash by country



This figure visually presents the estimated marginal value of cash for a set of 12 Eurozone countries the firms in our sample belong to. The marginal value of cash was estimated following the model of Faulkender and Wang (2006) but excluding the interaction terms with leverage and lagged cash in order to facilitate the interpretation of the confidence intervals for the estimate. The horizontal bars represent the interval estimate of the marginal value of cash given a 95% confidence interval based on panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence. Table 14 provides complementary information.

Table 14 - Summary statistics on the marginal value of cash by country

Country	Marginal Value of Cash	Range (95% confidence interval)	Observations	Firms
Finland	0.755*** (0.127)	0.506; 1.004	1100	139
Austria	0,605*** (0.123)	0.364; 0.846	596	73

Belgium	0.540*** (0.111)	0.322; 0.758	903	119
Ireland	0,532*** (0.174)	0.191; 0.873	331	48
Germany	0.509*** (0.054)	0.403; 0.615	4328	633
Spain	0.411*** (0.252)	0.252; 0.570	1210	174
All	0.378*** (0.030)	0.319; 0.437	18649	2648
Italy	0.368*** (0.058)	0.254; 0.482	1938	271
Netherlands	0.352*** (0.106)	0.144; 0.560	1014	132
France	0.349*** (0.057)	0.237; 0.461	5257	757
Greece	0.135** (0.275)	0.010; 0.260	1491	241
Luxembourg	0.087 (0.275)	-0.452; 0.626	105	15
Portugal	0.022 (0.114)	-0.201; 0.245	376	46

This table presents the estimation of the marginal value of cash for each of the 12 Eurozone countries that comprise our sample, in descending order. The interval estimates for each country, based on a 95% confidence interval, as well as the number of total observations and firms within each estimation are also displayed. Panel-corrected standard errors (PCSE) robust to heteroscedasticity and cross-sectional dependence are reported in parenthesis. Statistical significance is denoted by * at 0.10, ** at 0.05 and *** at 0.01.